Impact of the Introduction of the Legal Minimum Wage in Germany on Training Opportunities on the Workplace

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Abstract

The dissertation is examining training outcomes of the legal minimum wage in Germany. Human capital theory, labor market segmentation theory and labor economic approach constitute the framework of the analysis. We employ a quasi-experimental research design on the basis of the German Socio-Economic Panel for the survey years 2014 to 2016. Measuring the dependent variable, we differentiate between training incidence and intensity. Firm-level, individual-level job-related, performance-related and personal characteristics are introduced as regressors. For the treatment assignment, we use a subjective assessment derived from the branch tariff adjustment which allows differentiating between employees who have received a pay raise within the juridically prescribed period and those covered by the anticipatory wage adjustments. The analysis is performed using Random Effects Logit and First Differences Regression models and followed by the robustness check in the variety of post-estimation procedures. Our findings prove the fact that it is the wage adjustment point, and not the absolute sum of the income, that regulate human capital investments on the minimum wage labor market. The results imply that the law introduction has a moderate positive impact on training participation of the affected workers, which is further specified dependently on the choice of the outcome indicator. In particular, we find no statistically significant time trends for the training incidence within the observation period and attribute it to the inter-compensation between the shares of training costs bearers. Second, our findings imply that the announcement upon the minimum wage introduction induces a further increase in the employer-financed training incidence prior to the law implementation. Third, we detect an upward adjustment in the number of enrollments after the minimum wage implementation for the workers who have received a pay raise at this time. We attribute both statements to the developmental and production optimization strategies. Finally, the data provides evidences that the upcoming training costs are potentially absorbed by the negative shifts in the training volume. Work-related characteristics are the strongest predictors and their effect remain consistent with the predominant structural inequalities. The current research empirically contributes to the existing literature of the emerging minimum wage research outcomes in Germany, draws attention to the problematics of a tight connection between labor market and education inequalities and specifies selected aspects of training participation.

Key Words

Legal minimum wage, human capital investments, training incidence, employer-financed training incidence, minimum wage labor market, work-related characteristics.

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Chapter 1. Introduction and Problem Statement

In January 2015, minimum wage law has been officially implemented in Germany. Despite the pervious existence of tariff regulations, it became a major policy issue covering numerous economic sectors and employees. The nationwide hourly minimum wage has been determined at the level of 8.50 Euro gross independently from additional payments and bonuses adjusted to 8.84 Euro in 2017, remaining under further control in accordance with the actual economic situation in the country (MiLoG 2014). Exceptions on the individual level are provided for obligatory internship in terms of education, vocational company-based training, voluntary work, youth before 18 without completed professional qualification and long-term unemployed in the first six month of their return to the labor market. Established sector and workers' specific exceptional regulations are no signs of the policy's weaknesses but a way to prevent labor market discrimination by employing members of the underlined groups and a way to ensure gradual adaptation of the payment policy for the firm owners. The area of application of the law is the territory of German state; subsequently, all the foreign companies that have employees doing the major part of their work in Germany are obliged to confront as well. In short, the adoption of the law means that the price of the human resources has significantly grown, remaining all the other conditions unchanged (Bossler 2016).

The introduction of the legal minimum wage in Germany is a part of the general European trend (Vaughan-Whitehead 2010). The author summarizes the main reasons of the revival of this discourse in the countries' policies. Those are increased labor and capital movements and social dumping; new forms of employment contract, industrial relations developments and declining wage trends. In Germany, they are reflected in the following examples. Growing availability of guest workers, immigrants, labor force supplied by temporary agency workers agreeing on lower wages and less preferable labor conditions simplified the replacement of employees. At this point, introduced legal minimum wage fulfills the function of protection on both sides: prevention of undermining the labor of the already employed and ensuring the equal cost of the temporary and/or migrant workers. Besides, after the Harz reforms the number of people on "mini-jobs" has increased significantly. This form of atypical contract as well as traditional part-time jobs demand more labor market protection due to their strong connection to income insecurity, precarious employment and incomplete labor union coverage. The majority of the working poor are located in the mentioned labor market segment. Further, the system of collective bargaining

in Germany has not been generally binding. Its major vulnerability has been observed among small and middle-sized firms, whole business sectors (e.g. textile and clothing industry; agriculture and forestry) without union membership and/or work councils. That is why, outsourcing jobs to industries and companies with lower labor price has widespread. German case study (Bosch and Kalina 2010) delivers following evidences. Low-wage employment (less than 60% of the national median income) has raised not only among the traditionally defined vulnerable workers (unskilled, migrant, part-time workers, women) but across all the segments of the labor market. The described tendencies represent clearly the crucial importance of the legal minimum wage introduction for the German labor market.

When carefully adjusted to the current market situation, minimum wage shall not cause negative effects. In the European comparison, minimum wage in Germany is placed in the upper sector, both in terms of its absolute sum and under the consideration of the purchasing power standard (Schulten 2016). Taking into account the Kaitz Index of 0.49, which the author defines as the share of the legal minimum wage to the average wage in the country, Germany is located the middle field, that shall prevent negative law outcomes. For comparison in absolute numbers, in 2014 the median hourly wage for full-time employers was 17.9 Euro per hour (Daussin and Camille 2017). Most experts agree on the relatively stable economic situation (stable economic growth, high employment rate, low inflation rate) at the time when the law has come into force.

The importance of the legal minimum wage introduction for the labor market in a given country depends on the percentage of workers affected (Masso and Krillo 2010). In spite of the previous existence of the sectoral minimum wages and companies' wage tariffs, the law influences numerous segments of the labor market. According to the data of the German Socio-Economic Panel in 2014, 13,4% of the employees (17,8% for East Germany and 11,7% for West Germany) are affected by the law. VSE (Verdienststrukturerhebung) indicates the affection of 11,3% of all the labor relationship in the country with 9,3% in the West and 20,7% in the Eastern part. The IAB Establishment Panel estimates the effect based on the number of the companies. Those are 12% for the whole Germany (firms with at least one worker payed below 8.50 Euro), 24% for Eastern federal states and 9% of Western states (Mindestlohnkommission 2016). Exceptional transitional regulations [are no longer valid] have covered only 0,7% of all companies and 0,3% of the employees (Bellmann, Bossler et al. 2015). With regard to the latter, the effect of the law could be also analyzed in a cross-sectoral perspective. Following sectors has fallen under the transitional regulations: hairdressing and cosmetics industry, laundry and dry-cleaning products, agriculture, hunting

and related activities. The clear majority of the workers in numerous branches without the transitional regulations are affected: taxis, gambling and betting activities and restaurants (Mindestlohnkommission 2016). The calculations of Ifo Institut (Weber 2016) define hotels and restaurants services, agriculture and retail as three branches with the highest share of affected workers. Nevertheless, for some spheres (often classified as "classic high-wage branches" (Kathmann 2017)) the introduction of the legal minimum wage has almost no impact. For instance, in the building construction and civil engineering, production of vehicles and vehicle parts, financial services and public administration, the share of the workers payed below 8.50 Euro has been less than 2%. On the basis of socio-demographic characteristics, traditionally more vulnerable labor market segments (women, part-time employees und employees of small firms, working students and pensioners, low-skills jobs, unskilled workers, temporary contracts) are more influenced by the law.

Apart from directly affected workers and firms, indirectly affected ones should be taken into consideration. On the firms' level those are the companies affected by the adaptation measures of others (13% according to the IAB Establishment Panel (Bellmann, Bossler et al. 2015)). Ifo Institut (Weber 2016) reports the number of affected companies in total (both directly and indirectly), namely 46% for East Germany and 34% for West Germany. On the employees' level spillover-effect (change of the whole wage structure (Card and Krueger 1995, Mindestlohnkommission 2016) is often discussed. Due to the scope of the affected groups and the measure of the possible effect, the importance of the law in public, economic and political discourse is undoubted.

The major public debates upon the law cover the consequences of the law in comparison to its prior goals. Following objectives of the legal minimum wage introduction are defined at the EU level: fighting poverty and social dumping reduction, equity, industrial relations' and employment development (Vaughan-Whitehead 2010). Settled minimum wage shall ensure a living wage for the full-time work. Taking these expectations into account, the law has gained a widespread support in the German public opinion (Fedorets, Schröder et al. 2017). The difficulty at the current state of research of the legal minimum wage outcomes in Germany is to differentiate between temporary adjustment strategies of the affected actors and long-term outcomes, whereas the latter are simultaneously connected to the business cycles, external crises, political situation and etc. (Card and Krueger 1995). For this reason, the link between the observed societal changes and legal minimum wage introduction should be ensured on the theoretical level. The IAB Establishment Panel (Berge, Kaimer et al. 2016) suggest exclusively descriptive approach to the legal minimum

wage outcomes in Germany at the current stage instead of the causal analysis. Therefore, the final evaluation of the effectiveness of the law is still coming.

The core of the discussion within the consequences of the legal minimum wage is its employment effect. Three scenarios could be expected: fall, raise of the employment rate or absence of any change. The experience of the legal minimum wage setting in other European countries allows to make only uncertain predictions. Major employment adjustments have been observed while introducing legal minimum wage in Hungary and Malta. On the contrary, labor markets of Ireland and United Kingdom experienced growth of jobs caused by the combination of growing migration rate and law introduction. Polish example illustrates the absence of its effect on both employment and unemployment rates (Vaughan-Whitehead 2010). On the theoretical level, the following explanations are provided. Employment rate is supposed to decrease, because of the predicted fall of demand for a good (labor) that has become more expensive (Card and Krueger 1995, MaCurdy and McIntyre 2001, Fields and Kanbur 2007, Pollin 2008, Herr, Kazandziska et al. 2009, Müller and Steiner 2010, Brenke and Müller 2013, Hilgenstock 2014, Wojciechowski and Wollmershäuser 2015). In a long-term perspective labor could be substituted by machinery. In a short-term one, decreasing demand for labor may result in restructuring of the whole labor market, when workers leave low-paid sectors for better paid ones. The process has been observed in Croatia (Nestić 2010). The opposite effect [raise of employment rate] is explained by the changing of business cycles which means that higher minimum wage increases purchase power within the population which results in higher demand for goods and labor to produce them (Card and Krueger 1995, Pollin 2008). The third opinion is the absence of change of the employment rate, due to the fact that those having become unemployed because of the legal minimum wage introduction will actively search for jobs in other sectors, many of which become more attractive through the overall wage level increase (Herr, Kazandziska et al. 2009). Alternatively, employers might follow other strategies to cope with the raising labor price. Those will be discussed in detail in the passage below. Most of the reviewed research agree on the fact that careful setting and adjustment of the legal minimum wage prevents negative employment effects.

A comprehensive review of the development of the German labor market has been made by the Minimum Wage Commission (Mindestlohnkommission 2016). According to its information, no negative effects on the employment rate have been observed due to the introduction of the law. For April 2015, it has been raised by 1,3% in comparison to the same month of the previous year. No raise of the unemployment rate has been observed either.

Instead, structural changes, namely decrease in marginal employment due to its transition to the one covered by social security, have been observed (Berge, Kaimer et al. 2016, Caliendo, Fedorets et al. 2017). The number of transitions from marginal employment has raised, remaining newly established labor relationship persistent also one year after the law introduction (Berge, Kaimer et al. 2016). Possible explanation for the structural changes is German regulations for marginal employment ("mini-jobs"). With the wage raise, the number of permitted working hours for this employment form decreases significantly, whereas the obligation of the employers to pay social insurance for these workers remains the same (Hilgenstock 2014).

Reasons for the absence of negative employment effect in Germany are well summarized by Caliendo and colleagues (Caliendo, Fedorets et al. 2017). Those are better correspondence of the affected labor market segment to the monopsonistic rather than perfect competition; postponing the layoffs to medium and short-term by legal and intra-firm administrative hurdes; non-compliance and others. The major observed change is the drop down of the number of working hours (Mindestlohnkommission 2016, Caliendo, Fedorets et al. 2017). Both papers agree on the intensification of labor in the background of this change. The Minimum Wage Commission report also connects the change to the technical developments in the production process (Mindestlohnkommission 2016), whereas Caliendo and colleagues (Caliendo, Fedorets et al. 2017) analyze it in terms of increase in the overtime unpaid, non-compliance and employees' initiative to lower the working time to keep the eligibility for social security and tax benefits. These evidences provide a limited understanding of the labor market development after the law introduction, as the conclusions are given on a middle-term descriptive basis.

The absence of the crucial employment effects of the legal minimum wage in Germany shifts the focus of the discussion to the adaptation strategies of the companies towards the raising labor price. Following Vaughan-Whitehead (2010), the latter could become either "a quality enhancing high road" or "a cost minimizing low road". The first one aims to increase productivity through investments in human recourses and technologies, improve the quality of services and products. The second option is driven by the effort to pay the increasing costs of labor by saving on other ones, e.g. employees' dismissal or replacement by less-skilled labor force, shortage of fringe benefits and training, changes in the production process in favor of cheaper options and etc. As an example of the prevalence of the "low road" option author describes the case of the United Kingdom. The reasons behind are low supply of the skilled labor force and qualified managers, distrust of the firm

owners towards the national training system and constant increase of the international competition. On the contrary, Vaughan-Whitehead predicts the opposite situation for Germany. According to the scholar, the absence of the legal minimum wage has been a major obstacle for the employers to develop their companies following the "high road" model.

The report of the Minimum Wage Commission (Mindestlohnkommission 2016) provides an overview of the companies' adaptation strategies with respect to the law using the IAB Establishment Panel of 2015. The most popular measures named, apart from already discussed intensification of work (undertaken by 23,5% of firms, planned by 4,6%), are price raising (19,5% and 6,3% correspondently) and limitations in employing new workers (10,4% and 6,3%). One of the core differences between "low" and "high" road models is the strategy towards the affected workers reflected in possibly changing quality of their jobs. This concept includes the whole variety of non-wage aspects, e.g. fringe benefits like meals or job tickets, job intensity, development of human resources through investment in training, employee commitment and mobility, discouraging labor turnover (Card and Krueger 1995, Acemoglu and Pischke 2003, Vaughan-Whitehead 2010). These factors could become a powerful explanation for the absence of employment loses while introducing legal minimum wage (Cubitt and Heap 1999). The current state of research describes the situation only partially. Referring to the IAB Establishment Panel (Mindestlohnkommission 2016), the following measures has been mentioned by the affected companies: reduction of the investments (undertaken by 5,8% of affected firms and planned by 5,4%), increased usage of alternative (flexible) employment forms (2,6% and 2,4%), increasing (1,5% and 2,1%) and decreasing (1,8% and 0,6%) employees' training, substitution of the labor force through machinery (1,4% and 1,1%). Ifo Institute (Weber 2016) reports more dramatic figures on the undertaken adaptation measures with respect to the law [both direct and indirect affection is covered]: price increase (29% East Germany, 14% West Germany), shortage of working time (19% East Germany, 13% West Germany), investment reduction (18% East Germany, 10% West Germany), shortage of additional payments (17% East Germany, 11% West Germany), personal restructure (16% East Germany, 13% West Germany), no measures (44% East Germany, 59% West Germany). Those are not only simple outcomes of the legal minimum wage introduction, but a possible measure of its share in creating "high skill, high value" economy stimulating the investments in physical and human capital (Cubitt and Heap 1999).

Already in the foundations of labor market theory investing in the human capital has been regarded as the most valuable type of investment (Marshall 2009). Technical and

scientific innovations, their application to the production process and contribution to the improved productivity, have dramatically increased the value of knowledge that are mainly embodied in people (Becker 1964). Unlike other types of capital, individual knowledge and abilities are associated with changes in action and economic growth (Coleman 1988). Following the original definition, it can be defined as the activities that affect future profits through imbedding resources in people. Human capital theory in the foundations of Becker (1964) and knowledge-based view on the firm (Nonaka and Takeuchi 1995, Liebeskind 1996, Krogh and Wallin 2011) focus economic analysis on the individual knowledge and skills. Within both frameworks, investment in human capital is analyzed as the relationship between a firm and an individual based, on the one hand, on differentiation of their interests and, on the other hand, on the common goal of improving knowledge and skills. An important characteristic of the human capital theory is the prominent role of an individual in investment decisions, whereas firm becomes a mean to increase their private returns. On the contrary, within the knowledge-based view, individual is viewed as a mean to increase firm knowledge and improve firm performance. Both views agree on the crucial importance of human capital for the economic development, individual and firms' profit.

When discussing the improvement of skills of an active labor force, the concept of training has to be introduced. Together with education, these are two most important types of human capital investment. For this reason, earning degree at an institution that specializes in teaching is a preparatory stage within the career path, whereas specialization and acquisition of job-related skills happen mostly at work (Mincer 1993). Further education provides workers with basic and updated competencies, stimulates their motivation, sense of responsibility and attitudes conductive to productivity in work and strategic goals of the organization (Hashimoto 1982, Wilkinson, Bacon et al. 2010). Besides, employees' benefits from it include increased employment duration and continuity, payment raise and promotion (Wilkinson, Bacon et al. 2010). Nevertheless, its provision is limited by the challenging features of human capital in comparison to other productive forces, namely the possibility of movement to a competing firm, demand for higher payment, demotivation, dissatisfaction and authority rejections (Coff 1997). Uncertainty about the usefulness and returns on the investment are further barriers with this regard (Wilkinson, Bacon et al. 2010), as well as worker's motivation for learning (Xu and Lin 2011), incomplete information upon their skills and available training opportunities (Becker 1964). When considering continuing vocational training as a part of lifelong learning, it becomes a central characteristic to rank groups upon their participation in further education (Bilger and Strauß 2015). 70% of all

overtaken adult education activities are defined as employer-provided further training, which also makes their prevalence clear in comparison to individual investments. However, listed arguments and statistics makes both of them a complex and significant subject of the labor market research to be examined in a tight connection.

On account of the legal minimum wage introduction, unskilled and low-skilled work is one of the most affected segments of the labor market, experiencing the strongest wage growth due to the reform (Caliendo, Fedorets et al. 2017). Therefore, they are also the ones who face the greater risk of unemployment as the direct outcome of the law (Fedorets, Schröder et al. 2017). With reference to the report of the Minimum Wage Commission (Mindestlohnkommission 2016), these are 24,3% of all the employment relationships of the workers without a formal qualification and/or 21,5% of the jobs with low qualification requirements. If the calculations are performed on the employee-level, similar picture could be observed. According to the data of the German Socio-Economic Panel in 2015 (Kalina and Weinkopf 2016), around one third of the workers affected by the legal minimum wage (30,4%) did not have a formal qualification. Following the definition of the Federal ministry for economics and labor (Hieming, Jaehrling et al. 2005), those workers could not be called completely unskilled. Many of them have collected relevant professional knowledge and experience, although it is not formally certified. The same study states that the work of their majority goes beyond the tasks for which no qualification is needed. A further discrepancy is observed in the definition of "simple jobs" or "jobs for everyone", for which employees provide constantly raising application requirements, e.g. computer or soft skills. Due to the fact, that German industry is specialized in the field of goods and services of high quality, formal qualification has gained its importance even for the low-skilled work and, therefore, contributes to the falling demand for the workers without professional certificates. Legal minimum wage introduction has enforced the tendency towards higher employment (Mindestlohnkommission 2016) and productivity (Agell and Lommerud 1997) requirements. An example of this contradiction is the debate to raise the exception for the long-term unemployed up to twelve months to support their chances for being recruited. Therefore, unfavorable labor market perspectives (e.g. higher risks of unemployment and underpayment (Kalina and Weinkopf 2016)) of the described group are becoming worse.

Apart from that, it is not only workers without the professional qualifications performing simple jobs. Skills' mismatch (Hieming, Jaehrling et al. 2005) is often observed when qualified applicants do not have professional capabilities expected by the employers. Accepting these jobs might be the way to avoid unemployment, as a well as the

compensation for a better work profile (package) or promotion perspectives. The field of simple work is associated with lower labor productivity and underpayment, as well as limited developmental perspectives. In terms of the legal minimum wage introduction, it is another two thirds of the affected employees having completed vocational training or academic degree. Since January 2015, there are no legal instruments of abusing this labor market segment independently from the qualification level of the workers or job they perform. The tendencies described above provide two possible implications for the firm owners. First, massive dismissals and replacement of unprofitable workers by the those who are better qualified and/or machinery. The statistic provided has not given widespread evidences for that. Second, the employers might decide in favor of improving the productivity of existing workers through providing additional training for them (Acemoglu and Pischke 2003). However, the power of this argument is restricted by the pressure on the employers to cut on the expenditures, wherever possible, due to the raised labor costs. Wage increase especially by the unskilled workers remains sensible with regard to the learning perspectives for them. This implies that legal minimum wage introduction might become either an already mentioned step towards "high skill, high value" economy (Cubitt and Heap 1999) or an additional restriction of labor market chances in the sector of low-skilled/ low-payed /simple jobs that are a target group of the legal minimum wage introduction. The named aspects provide a strong link between social and economic aspects of labor market theory and ongoing political debates upon the reasonability of the law.

Taking into account all the provided evidences and arguments, the current paper will answer the following research question. What is the impact of the legal minimum wage introduction on employees' training in Germany? It is going to contribute to the ongoing studies of the law outcomes directly after its introduction and, therefore, especially valuable. The paper is going to proceed in the following way. In the first chapter the theoretical basis of the influence of the legal minimum wage introduction on the training opportunities on the workplace is going to be critically examined. In the next part the empirical analysis is going to be performed on the data of the German Socio-Economic Panel. Implication of the results and conclusions will be provided in the final chapter of the paper.

Chapter 2. Theoretical Framework

2.1. Outline

The goal of the following chapter is to define the theoretical background of the analysis of the impact of the legal minimum wage introduction on training opportunities on the workplace. It includes the nature of connection and reasons behind, macro-, meso- and micro level characteristics influencing it and conceptualization of training notion. Existing literature on the topic is going to be critically reviewed to define existing research gaps and derive the objectives for the current study.

Our research takes the perspective of labor economics approach to analyzing training, which is based on the human capital theory of Becker (Wilkinson, Bacon et al. 2010). Therefore, structural and subjective factors of participation in training, as well as its effect on individuals, organizations and economy will be approached. Following the perspective of Becker, it is the same pool of characteristics determining employer's and worker's investment in the human capital of the latter. Therefore, they will be viewed together with necessary differentiations between both where necessary. Additionally, human resource management perspective will be incorporated through understanding the training provision in social exchange theory (Wilkinson, Bacon et al. 2010). On the one hand, training is perceived as a resource provided by employers to help their workers, demonstrate support and caring. The latter view it as commitment and investment, responding with increased effort and cooperation. Last but not the least, is inclusion of industrial relations approach while operationalizing training concept, focusing on employee, the amount of training provided for him and working practices and conditions promoting training.

The chapter consists of the following parts. First, the general logical link between the legal minimum wage introduction and employer-provided training will be discussed using existing empirical studies within the field and their theoretical implications. Second, the theory of human capital will be reviewed with relation to the current research question. Third, the concept of postgraduate education and its special characteristics with relation to the analyzed group will be discussed. Within the final part the conclusions upon existing theoretical gaps and solutions that will be applied for them in the current study are going to be presented.

2.2. Legal Minimum Wage Introduction and Human Capital Investments

As it has already been noticed in the introduction, the link between the legal minimum wage introduction and training is an essential part of the research of the outcomes of the legal minimum wage. Its shortage as well as increase could become an important adaptation strategy of the firm towards the law to avoid massive dismissals. In the first case, training is viewed as an additional expenditure for the firm owners and, therefore, shall be reduced to compensate for the raising labor price. In the second case, further professional education is a way to make the workers more productive so that the increased price of the labor pays off through an optimized production process. Deepening existing training provision inequalities is included into discussion as the third definition of the outcome. Self-explaining is the absence of any impact of the law on training provision if the firm owners do not incorporate it as a management instrument at all. Law introduction might also affect individual investment decisions. The detailed theoretical explanation for these links is presented below. Due to the short time since the introduction of the legal minimum wage in Germany, it is mostly foreign research (mainly United States and United Kingdom) that build the theoretical contribution of this section.

Most of the studies upon the link between two analyzed concepts prove the competitive labor market model and Becker's human capital theory predicting the negative impact of the legal minimum wage on training provision. The starting point is the fact that a large share of human capital is accumulated on the job and workers finance their training accepting lower wages. If no training had been provided, workers would have received higher wages, but they choose the other way in order to invest in their human capital expecting future returns (Becker 1964, Acemoglu and Pischke 2003). The alternative explanation outside human capital theory is that lower wages could be also accepted due to their compensation by fringe benefits (e.g. transport or meals) (Fairris and Pedace 2004). The processes of wage negotiations, as well as background of financing training through lower payment are difficult to support empirically (Lechthaler and Snower 2008), therefore it is only possible to use statistic indicators of training provision as evidences. The negative impact of the legal minimum wage on employer-provided training has been empirically proved by the wide range of studies using different methodology, both firms and individuals as the units of analysis (e.g. (Mincer and Leighton 1980, Hashimoto 1982, Schiller 1994, Neumark and Wascher 2001, Haepp and Lin 2016)). Brunello (2001) proves this conclusion performing the analysis on the international level, indicating less amount of provided training in the countries with higher minimum wages. Shortage of the training opportunities on the employers' side is also driven by the mentioned necessity to cut on the

expenditures. Apart from the direct costs, training is connected to the range of indirect ones like wasting raw materials, production of the defected goods, damage to the equipment because of mistakes in usage while educating (Becker 1964, Hashimoto 1982). Before the reasonability of the application of these theoretical arguments is discussed in the German context, alternative explanations of the link between two analyzed concepts will be described.

Higher legal minimum wage makes it unprofitable to employ unskilled workers (Acemoglu and Pischke 2003). The alternative solution for the revision of the labor costs might be improvement of the quality of already existing work. Human capital model predicts the productivity growth as a direct outcome of the human capital investment, namely further training (Barron, Black et al. 1989). Therefore, introduction of the legal minimum wage may stimulate the employers to supply further education opportunities for the workers. The theoretical model is created on the basis of the perfectly uncompetitive labor market, therefore there is only a limited amount of empirical evidences provided for its support (e.g. (Cubitt and Heap 1999, Arulampalam, Booth et al. 2002, Acemoglu and Pischke 2003, Metcalf 2004).

Within the quantitative methodology of the research it is difficult to capture simultaneously all the incentives for employers to reduce or increase training as well as reasons for the workers to accept lower wages. Although on the theoretical level perfect causation between two patterns is assumed, there is no doubt that the effect of the law is impossible to separate from other economic processes. Besides, training provision is connected to the range of own independent predictors. The third group of studies consist of those that indicate no impact of the legal minimum wage on training provision (Grossberg and Sicilian 1999, Fairris and Pedace 2004). As an additional explanation for the absence of substantial fall of the employed rate despite unprofitability of employment of unskilled workers, labor-labor substitution could be mentioned (Fairris and Bujanda 2005). Only the workers matching a productivity floor are selected (Agell and Lommerud 1997). Hungary is an example where unskilled employment was significantly decreased for this reason, with poor career perspectives for the outsiders (Köllő 2010). The choice may be performed not only on the qualification (skill) basis but express the "taste of discrimination" towards certain workers' groups arbitrary chosen by employers (e.g. migrant workers, women). Firm owners would search for the employees who already poses the capabilities needed for the optimization of the production process instead of helping the existing workers acquire ones. An alternative notion is the "hires of a better quality" (Lang and Kahn 1998). Last but not the least, no strong effect on postgraduate education will also be expected when the latter fulfills mainly the abilities' screening and evaluating function with the aim of identifying the most capable workers (David 2001). The

named factors could be examined when more specific information about the affected actors is given.

The same mechanism of maximization the future benefit and choosing the most profitable investment alternative is embedded into the individual decision to invest in their human capital (Belman and Wolfson 2014). A differentiating feature at this point is that there is no uncertainty upon who would profit from the investment and loss in case of movement to another firm. The authors find that the negative effect of minimum wage on individual investments is reflected in school drop-outs among teenagers to pursue better employment opportunities. As initial education stands beyond the scope of the current paper, this link will be not discussed further. However, it is important to keep in mind that for workers longer working hours become a more profitable opportunity than training, therefore, this might negatively affect their own training decisions. Cahuc and Michel (1996) discuss alternative explanations of the positive influence of minimum wage on individual investments. Minimum wage raises the demand for the high skilled labor in comparison to the one of the low-skilled. This motivates the latter to qualify for the jobs and increased employment requirements. Apart from the direct effect on the worker's investment initiative, the one of the firm owner could face an indirect negative effect with this regard. The reverse mechanism is reasonable to expect either. Employees' increase own training investments in response to the shortage of firm-financed training (Hara 2017).

Bellmann and colleagues (Bellmann, Bossler et al. 2017) discuss the relevance of this evidence in the German context. They bring into discussion training subsidies as the third source of human capital investments and, therefore, explanation for the absence of the employment effect. The latter cover both employer's and employee's training initiative and are of a major importance in Germany, where additional budget for qualifying the unemployed and employed in danger of dismissal has been introduced with regard to the law. The theoretical link upon the integration of the different kinds of human capital investments remains weak. In terms of the newly introduced arguments, we could predict the stability of the overall training participation due to the inter-compensation of different sources for human capital investment. Nevertheless, the characteristics of worker's credibility outlined by Becker are relevant for all of them in most economic contexts and, therefore, should be placed in the focus of the discussion.

Apart from direct training costs, human capital investments also include hiring expenses, fees for employment agencies, open position advertisements etc. According to Becker (1964) they should be considered so due to their positive impact on productivity

[although not improvement of skills and knowledge] and loss of value, when the worker leaves. For an individual, they are reflected in the costs of gaining additional knowledge upon employment opportunities. In Germany, the reduction in hires has been detected as one of the employment outcomes of the minimum wage introduction (Bossler and Gerner 2016). Therefore, the risk of reduction of training investments for this reason has to be excluded.

Although the current paper focuses on the training outcomes of the minimum wage introduction, those do not remain isolated from other adaptation strategies. Hirsch and colleagues (Hirsch, Kaufman et al. 2015) introduce the concept of the channels of adjustment that describe the blocks of changes through which labor price increase influences the behavior of firms, which, in its turn, affects employees, consumers, stakeholders and other agents. Described labor market models are then characterized by different mixes and strength of adjustment channels. Therefore, the cost of the minimum wage is not attributed to single adaptation strategies but absorbed through a wide range of the channels of adjustment. The German labor market review upon the first outcomes of the law presented in the introduction proves the described theoretical approach. Nevertheless, channels of adjustment do differ in their relative weights for the overall company's adaptation strategies and authors emphasize the importance of the human-related and internal operational ones. Training on the job is one of those. In its general terms, we relate the channel of adjustment concept to the "high" and "low road" dichotomy discussed above.

The complementary concept applied for the employee's side is the pattern of the worker's subjective gains. It is applied for the research of the positive effects of the minimum wage introduction on the different dimensions of personal and professional well-being (Bossler and Broszeit 2017, Pusch and Rehm 2017, Gülal, Ayaita et al. 2018). With regard to framework introduced in the previous paragraph, those reflect the workforce reaction towards different channels of adjustments. Productivity increase is regarded as the central one in the German case as the response towards the increased labor demands for the minimum wage legitimate employees (Pusch and Rehm 2017) and a prominent reason for the absence of the shortage in labor demand for other groups of workers (Bossler and Broszeit 2017). Pusch and Rehm (2017) name following changes in the work organization from worker's perspective: the reduction in the number of unproductive tasks and disruption, necessity to cope with more difficult problems, increased workload and resulting higher need for further education. Therefore, workplace optimization and related challenge of further qualification is beneficial not only from the company's and country economy perspectives, but also contributes profoundly to the overall job and life satisfaction of the affected employees.

The discussed results give only a holistic introduction of the impact of the legal minimum wage on on-the jobs training, as additional factors on the individual, firm and state level has not been accounted for. The purpose was to give a general understanding and logic of the studied link which creates a background for the theories discussed within the next chapters. The prominent works of the field prove an overall tendency of the contemporary labor market research: domination of the economic theories over those from the political and social sciences (Haupt, Sesselmeier et al. 2015). Interdisciplinary approach in the construction of the theoretical framework seeks comprehensive coverage of the topic and not diminishing the contributions of single disciplines.

2.2.1. Country-Specific Characteristics and Training Participation

The current chapter opens the discussion upon different factors on micro, meso and macro level that mediate the relationship between the two analyzed concepts. So that one could understand the nature of this connection, it is important to account not only for emerging characteristics while introducing the law (e.g. Kaitz index) but on constants that had defined the amount of training provided previously. If the latter has been a priority before the law introduction, it is likely to remain so after it (Heyes and Gray 2003). The theoretical concepts defining training provision on the country level (Brunello 2001) will be applied on German context.

Further training is a way of educating; therefore, it should be analyzed in a close connection with the whole educational system and consequent skills' level across the state. First, the mentioned research predicts that training participation is higher in more developed the countries with a more educated labor force. The assumption behind is the fact that the supply of training increases with the supply of more qualified employees, as firms are stimulated to open and occupy vacancies for the skilled jobs. The same factor is a powerful stimulus for the workers to improve their competencies to be promoted. With its share of educated labor force (employees with upper-secondary and more than upper-secondary qualifications, 61% in total) Germany is placed in the middle part of the continuum in the European comparison (Quintini and Pouliakas 2014). Besides, the supply of training is going to be less in the countries with a more stratified schooling system. Comprehensive schooling reduces specialization in favor of students' flexibility, so the latter would require more training on the workplace within the chosen occupation fields. Germany is characterized by a stratified school system, where a large

share of formal education happens on the workplace (Allmendinger 1989). Therefore, if the students keep their workplace after the graduation, the need for their further training may be reduced.

The second group characterizes employees' protection on the labor market. On the one hand, it is high union coverage that increases wage compression, reduces turnover and encourages firms to sponsor training. Although labor unions in Germany enjoy major influence on wages and labor conditions, their density remains rather low in comparison to Scandinavian countries (OECD 2016). For the year 2013, it is 67-69% in Finland, Sweden and Denmark versus 18% in Germany. On the other hand, employment protection increases turnover costs and discourages involuntary separation potentially favoring investments in the human capital. Within the same OECD dataset, it is measured as the strictness of employment protection (individual and collective dismissals) separately for regular and temporary contracts. Germany is the upper cluster in the first case and below the average in the second case, which would be reflected in a better developed training system for the workers with permanent contracts in comparison to temporary ones. Last but not the least, is the existence of federal subsidies to cover training incentives of both employers and employees (Bellmann, Bossler et al. 2017) to support the unemployed or workers in danger of becoming so.

The institutional characteristics indicate potentially selective approach in training provision for German workers. On the one hand, its need is reduced by the stratified school system. On the other hand, the demand for it will be maintained by the share of the highly qualified labor force [most probably enjoying high union coverage]. These assumptions are illustrated by the following statistics prior to the law implementation. According to Adult Education Survey (Bilger and Strauß 2015), 37% of adults (age: 18-64) have taken part in employer-provided professional training. Nevertheless, when discussing human capital investments, the decision is made on the firm (employer-provided training) or individual level, placed in the country's context.

2.2.2. Firm-Specific Characteristics and Training Participation

A substantial part of the research upon the discussed topic agree on the issue that training provision is negotiated within the firm development strategy (Wilkinson, Bacon et al. 2010), so it is reasonable to use single companies as units of analysis. Need for specialized skills, introduction and usage of high performance work systems generally influence decision upon

that in a short and long-term perspectives. Before single firm characteristics are discussed, it is important to look at contextual ones, namely region and business sector, as they determine the whole market conditions of the firm.

Region, namely East and West division, is an inevitable control variable for most research subjects in Germany. Although national standards of further education determine training provision for the whole country, path-dependency for both regions should be kept in the background of interpretation. For example, it could be illustrated through labor force composition with the larger share of skilled workers in East Germany after unification (Fitzroy and Funke 1998), driven by the right and obligation for professional education in DDR (Herkner 2015). There could be no clear-cut conclusions made on this basis because of the labor force migration after unification and incomparability of training and technological standards (Fitzroy and Funke 1998), which, according to the authors, are qualitatively higher in the West. The motivation to keep up to them as well as previous tradition of learning organization might explain slightly higher participation rates in further education in East Germany (42%) in comparison to West (36%), as reported by Adult Education Survey (Bilger and Strauß 2015). Nevertheless, these rates also illustrate previously observed convergence tendency in the regional division (Schiersmann 2007). Taking into account that East German firms face more substantial wage growth than West ones, effect of legal minimum wage introduction has to be higher there (Mindestlohnkommission 2016). Regional differences could be also observed through comparison between rural and urban areas. The latter are associated with stronger labor market positions of employees (Leuven and Oosterbeek 2000), and consequently higher rates of training supply (Böhm-Kasper and Weishaupt 2002, Offerhaus, Leschke et al. 2010). The inclusion of the concept as a single variable is connected to the range of inconsistences like several locations of the same firm, job rotation between them, commuting, classifying suburbs etc. Therefore, it will not be incorporated into the current analysis.

The determination of *business sector* is observed through the level of competition and profitability, labor market compositions, management expertise, access to the capital (Arrowsmith, Gilman et al. 2003). Extent of training provision is also dependent on the level of technological development in the branch. When it is low, there is little incentive to invest in training, as there will be no opportunity for the "upskilled" workers to perform "upskilled" tasks in the same company (Bassanini and Ok 2004). This pattern is discussed in terms of the qualification requirements and knowledge intensity of the tasks within the branch, attributing lower training participation to construction and hospitality industries, where both are relatively low (Schiersmann 2007). Another factor outlined by the author is the organizational aspect of

work. Namely, group and project work are reported to influence positively training participation. Nevertheless, Schiersmann omits a generalized conclusion due to the ambiguity of sources of the observed discrepancies. Sector differentiation is especially important in Germany, due to the established dual system (Kathmann 2017) of wage negotiations: previously existing sector-specific tariff regulations and newly introduced nationwide minimum wage.

The following statistical distribution of the participation in further training across sectors illustrates these theoretical assumptions (Bilger and Strauß 2015). The two sectors with its major shares are public services (64% of employees) and non-profit associations (62%). Clear differences are observed across private sectors providers (44% in general): 46% in production industry, 35% in commerce, 45% in other services. Positive externalities (e.g.) funding is a possible explanation for higher participation rates in the public services and non-profit associations. At the same time, private sector providers might be often discouraged by the imperfect competitions on the market for skills and information failures (Abramovsky, Battistin et al. 2011). Production industry is leading potentially due to higher level of innovation, technical and organization environment, staff and qualification structure and labor conditions (Dobischat, Seifert et al. 2002). Mentioned statistics on the most affected by the law sectors should be also taken into account while predicting its impact. As already discussed above, the most affected sectors are hotels and restaurants, agriculture, retail, gambling and betting activities, taxis. Those characteristics are structural factors for the participation in training, further mediated on the firm level.

Further important index is the *company size*, as the researchers agree on the disproportional affection of the small firms by the legal minimum wage (Mindestlohnkommission 2016). Besides, due to a limited access to the capital and shortage of skilled staff, small firms are reported to provide in overall less training for their employees (Arrowsmith, Gilman et al. 2003, Heyes and Gray 2003). Large companies enjoy more advanced technologies, and consequently attract more qualified employees and experience lower labor turnover (Leuven and Oosterbeek 2000). The theoretical assumption is proved by the statistics of Adult Education Survey (Bilger and Strauß 2015). Labor relationship in small firms could be viewed through two major perspectives. On the one hand, they are driven by close physical proximity between the manager and workers, lack of hierarchies and often specialists, and therefore, rather informal "give and take" negotiations (Arrowsmith, Gilman et al. 2003). It often leads to lower wages than in large companies, which is, however, accepted by the employees due to a more congenial work environment. In terms of this perspective, setting legal minimum wage has only limited influence on the wage negotiations (Tzanov 2010)

and creates relatively little pressure for the employers to provide higher pay, which is then mainly compensated through work organizational changes. The informal nature of labor practices and their negotiation, multifunctional positions of employees complicate the research within this field. The alternative view on the work of the small firms introduced by Arrowsmith and colleagues (Arrowsmith, Gilman et al. 2003) is based on their incapability to influence the high competitive working environment they are existing in and their major vulnerability towards it. That is why, the introduction of the legal minimum wage would have following outcomes: decreasing profitability, massive dismissals and incorporation of illegal practices. It is also valid to predict rather low probability of the positive boost of training (Heyes and Gray 2003). The latter is still going to be attributed to an effort to offset the increase in the labor costs, rather than a planned developmental strategy.

Arrowsmith and colleagues (Arrowsmith, Gilman et al. 2003) define three groups of firms on the basis of their reaction towards the legal minimum wage introduction. The first group consist of those where the wages had been already settled above the established minimum wage and, therefore, not facing major influence. The second group of firms move to the "black market" employment due to the reasons discussed above. The third group considered reposition themselves in the market and revising existing arrangements. It becomes clear that the firm economic behavior before the law introduction influences the adaptation strategies towards it.

Heyes and Gray (2003) specify their research using the importance of the training provision before the law introduction as a predictor of its later impact and use qualitative methodology. The assumption behind is the stability of firm owner's decision to provide training or refuse from it within the general managing strategy independently of the newly rising labor costs. Although this statement falls into the major critic through the theoretical points introduced at the beginning of the chapter, it might explain relatively low changes in the provision of training according to the IAB Establishment Panel 2014 on the adaptation strategies mentioned in the introduction. Namely, it is 1,5% of the participating firms having increased further training and another 2,1% planning to do so. At the same time, 1,8% of the companies have reduced the amount of provided further training and 0,6% plan this measure (Mindestlohnkommission 2016). In general statistics of 2014, 61% of the participants in professional training report company incentive in its provision and 70% - cost coverage of further education by the firm-owner (Bilger and Strauß 2015). This policy is regulated within the general investment strategy which is dependent on the discussed sector specifications as well as individual decision of the firm owner.

The reaction that Heyes and Gray (2003) predict in response to the law is the adoption of a more strategic approach towards training instead of its radical change. For the companies where training has been important previously it might mean focus on the quality of education provided, updating the staff about learning possibilities, simulating self-learning, enhancing skills or control and reduction of training costs through dismissal of staff who learn slowly or pressure to finish the training earlier. The absence of such reaction is accounted for the factors having formed before the legal minimum wage introduction and making the firm owner refuse from human capital investments. These are wage costs, high labor turnover and low demand for highly trained employees. The authors also indicate possible indirect outcomes of the legal minimum wage introduction. Those are improved quality of goods and services due to the intensification of work and [in case more strategic approach towards training has been overtaken] learning transfer of the acquired skills. The paper provides "a soft solution" for the analyzed problem and serves as a valuable contribution to a broader understanding of the influence of the introduction of the legal minimum wage in terms of the general firm strategy and policy.

One of the few studies upon actual the short-run consequences of minimum wage in Germany is the paper by Bellmann and colleagues (Bellmann, Bossler et al. 2017). They use the data of the IAB-Establishment Panel for the years 2011-2015, applying difference-in-difference method on the firm level. The authors conclude upon the absence of the negative impact on training incidence but on training intensity in the affected establishments, mostly driven by the employer-sponsored training. Reduction of vocational education opportunities has been observed for medium and high-skilled employers, with no impact on the low-skilled ones. Although a detailed information is gathered upon training provision (distinguishing between three types: external, internal and on-the-job) and financing (solely firm-financed and one including worker's expenditures), its little amount is available for the employee's characteristics. Although skill group is one of the central determinants of job performance, we have the reasons to believe that training participation is affected by the range of further individual characteristics. The authors also agree on the necessity of extension of the findings to individual-level analysis. Despite the outlined limitations, the study contributes profoundly to the current research question.

To draw a conclusion, it is the limited access to the capital, shortage of high-skilled workers, informality of business relationship and firm biography that mediate the relationship between the legal minimum wage introduction and provided training. Besides, it is important to keep in mind that large companies and/or highly developed sectors attract better qualified

employees, more motivated to participate in training and invest in it themselves. Following the logic of the approached scholars, even negotiated on the firm level training strategy finds diverse application for different groups of workers. Consequently, it is reasonable to proceed with the review of individual characteristics influencing human capital investment as the central part of the theoretical framework.

2.2.3. Individual Characteristics and Training Participation

This chapter presents an overview of the individual characteristics of workers influencing investment in their human capital. The same factors are in charge of the rate of employer-financed training, individual investments and change of both when legal minimum wage law is being introduced. These theoretical assumptions are embedded in the human capital theory (Becker 1964). The key principle of their differentiation is credit constraints. It means that investment is made in the human capital of those workers who are expected to provide the most future profit with the least share of loses and risks (Lechthaler and Snower 2008). According to the authors, this decision is completely arbitrary and subjective. Besides, training is related not only to the employee's current workplace, but to their general employability (Dobischat, Seifert et al. 2002). Therefore, workers' individual characteristics indicated by Becker (1964) as ones potentially influencing it, will be in focus of this chapter. For conceptual differentiation, we divide them into job-related, performance-related and personal. The differentiation between firm-specific and general training in terms of the human capital theory will be first omitted and discussed in the next part of the theoretical overview.

Following the logic of Becker and its prominent interpretations (Becker 1964, Grossberg and Sicilian 1999), the major part of investment in human capital occurs at the beginning of the employment, therefore shorter work duration by the current employer (*job tenure*) implies higher training provision. Nevertheless, training itself limits labor turnover and its provision often solely fulfils this function (Mincer 1988), therefore the causal link in the opposite direction is possible either. In the case of the entry labor market, the indicator is closely connected to other job-related (e.g. job complexity), performance-related (work experience) and personal characteristics (age). Those will be approached in the respective paragraphs.

When discussing technological development and optimization of the production processes, *job complexity* often takes the focus of attention. Nevertheless, their direct link becomes less obvious when operationalizing the concept. Work complexity is reflected in the

employee's function and nature of job tasks (Cole 1992). It could be measured through objective (personnel requirements to be employed on the position) or subjective indicators (information about the job and activities performed from the incumbent) (Nedelkoska and Patt 2015). Both are dependent on macro (industry, workforce characteristics and industrial climate) and micro influence (type of technology used on particular position) (Hoffmann 1999). The prominent approach implies using objective measurements, as employees are not always aware of the distribution of the jobs, so they mostly compare their tasks with a limited set of familiar positions (Nedelkoska and Patt 2015). Besides, this perception is relative to their own individual ability. In terms of objective indicators, job complexity is a complement to the worker's qualification, discussed below. According to the data of the IAB Establishment Panel (Bogai, Buch et al. 2014), there is a direct ratio between the worker's and job's qualification levels. The current tendency of constant development of skilled work leaves little chance for people without formal qualifications, as almost a half of simple jobs (44,7%) is occupied by persons with the already lowest professional (school) qualification.

The cognitive demands of the jobs are constantly raising through the proliferation of computers, growing complexity of production and globalization of the division of labor (Nedelkoska and Patt 2015). Therefore, lower productivity of the simple jobs has become one of the major challenges of the rising labor costs through the legal minimum wage introduction. In general words, improving productivity means substituting low-skilled for high-skilled labor. Apart from dismissals and raising application requirements, it could be dome through redistribution of tasks among existing positions or creating new kinds of jobs (Piore 1968). In this case, legal minimum wage becomes an incentive to optimize routine and repetitive tasks through innovation and finding new ways of doing the job. Innovation includes skills development, possible both for the simple and complex jobs, dependently on the company's strategy. Complex jobs impose higher cognitive tasks on workers, and, therefore, are traditionally associated with a wider scope for improvement and returns, and consequently, higher amount of further training (Wilkinson, Bacon et al. 2010, Nedelkoska and Patt 2015), whereas simple tasks are often seen as peripheral and lacking promotion opportunities (Mangan 2000). Though, a need to improve productivity of the latter [and, its lower cost in comparison to complex ones, (Leuven and Oosterbeek 2000)] is the basis to expect raising provision of training for the simple jobs. On the employee's side it is reflected in the mentioned initiative to qualify for better jobs (Belman and Wolfson 2014).

The impact of digitalization is also analyzed with regard to the complete substitutions to the range of jobs. We address a comprehensive review with this regard (Dengler and Matthes

2015). According to the authors, helpers' and specialists' jobs are more probable to be replaced by machinery than those requiring high qualification and/or more complex ones. Therefore, it is reasonable to expect higher rates of human capital investments for the latter. The same is true for social and cultural services that have much lower substitutability potential than industrial professions. Further data upon the dynamics of changes in the companies' qualification structure is needed for more generalized conclusions with this regard.

Due to the multidimensionality of the job complexity concept, empirical evidences remain limited. Authors indicate the difficulty to predict the nature of organizational changes on the basis of previous experience (Piore 1968). Besides, it is often a matter of skill adjustment rather than radical change (Pannenberg 1996). The current state of research (Grossberg and Sicilian 1999, Acemoglu and Pischke 2003, Vaughan-Whitehead 2010) support these assumptions rather theoretically. Institutionally comparable French case proves the impact of legal minimum wage [in the combination with other instruments of employment protection legislation] on optimization of production process in food processing industry through automatization combined with training and multiskilling (Caroli, Gautié et al. 2010). Available statistics on participation in training on the job depending on the job function in 2012-2014 (Bilger and Strauß 2015) provide two implications for the theory. First, selection matrixes reproducing social inequality remain stable, as operative workers receive training the least (37%), followed by specialists (58%) and managers with the highest level of training participation (69%). Second, there is a tendency of raising the participation in training for operative workers (further education in general: from 34% in 2007 to 44% in 2014; continuing vocational education: 30% in 2012 to 37% in 2014). This change is more profound that the one for specialists (4% - training on the job, 2% further education in general) and managers (-1% and -2% correspondently) and is an important sign of the optimization of production process for this group of jobs. To draw a conclusion, inequality in training provision based on the job complexity is going to remain after the law introduction, thus with further potential increase in training for simple jobs.

For Becker (1964), one of the basic principles of differentiation in the human capital investments is the amount of switching between activities. From the employer's perspective (Becker 1964, Cole 1992, Wilkinson, Bacon et al. 2010) it implies that firm owners tend to invest more in the employees who are more likely to stay longer in the company to collect the most returns from the investment. The same could be stated about workers having more profound incentive to invest in the activity that they do on a permanent, rather than temporary basis. The described concept could be defined through the *contract duration* (temporary or

permanent) and/or *employment type* (full-time, part-time, marginal). As irregular employment has become a norm on the German labor market, the discussion gains further importance (Münchhausen 2007). According to the author, human capital investment is long-term oriented, therefore atypical employment forms are limited in training opportunities. It is combined with the fear of firm-owner that those who are low-skilled will not be able to use the knowledge, whereas high-skilled ones might prefer to leave for another firm in the absence of employment guarantees. Organizational commitment (Colquitt, LePine et al. 2000) is maintained weaker both by the employer and employee. Often it is the matter of limited employment time (Münchhausen 2007), making it impossible to use for training. In the case when workers are systematically changing tasks, their certain performance level is expected in the background and there is no motivation for both sides to improve the performance sustainably. Negative impact of these factors is strengthened when workplace is often changed, which is inevitable in terms of temporary contracts.

Adult Education Survey (Bilger and Strauß 2015) delivers following statistical implications. First, there is no significant difference between participation in professional training in 2014 for permanent (53%) and temporary contracts (54%), despite the expected difference of both on the contextual level, discussed in the first chapter, and individual level. The possible explanation behind is the fact that for the persons employed on the temporary contracts, competence development might become a compensation for unstable professional situation or primary motivation to overtake the position, possibly with transition to permanent employment. Another way to define the duration within which employers can collect their investment in worker's human capital is the form of employment: full or part-time. The theoretical assumption is supported by the rates of training participation (Bilger and Strauß 2015): 42% for people employed on the part-time basis and 52% for those on the full-time contract. In case of the negative effect of minimum wage on training, mini-jobs and part-time positions are the most vulnerable to shortages, unless their transition to full-time employment does not take place, which is a widespread case for Germany (Berge, Kaimer et al. 2016). Both contract duration and form have to be controlled for, as these concepts are often overlapping.

The discussion upon the performance-related individual characteristics is driven by the generating assumption of education research, namely that learning processes are strongly connected to selection matrixes that reproduce social inequality (Dobischat, Seifert et al. 2002). When the latter is considered within the human capital framework, performance-related characteristics could be used to measure the equality of opportunities. It is recognized that the introduction of the legal minimum wage gives the rise to the existing skills inequality in terms

of its impact on the training opportunities (Lechthaler and Snower 2008). It means that after the law adoption lower ability workers would participate less in the training being placed into the "low-skill trap" and higher ability workers enjoy its further raise.

When highest achieved *formal qualification* is considered, education and training become complements (Brunello 2001). It implies that training incidence is higher as the professional degree acquired by the employee raises. The theoretical explanation for this phenomenon provided by Becker (1964) is the fact that future economic value of the investment in human capital depends on the individual's set of skills and, thus, is higher by the abler persons. In other words, abilities acquired in the initial education form a basis for more advanced skills provided through postgraduate education (Katz and Ziderman 1990). Nevertheless, high school graduates also spend longer time in education allowing to accumulate more skills so that less job-related training would be needed afterwards. Apart from that, competencies developed without acquiring a formal degree might have an impact on performance on the workplace. Therefore, it is necessary to separate overall *duration of education*. Besides, investment in low-qualified employees is often connected to the lower economic returns combined with higher training costs, as they might take longer to master easier operations (Fouarge, Schils et al. 2010). The latter also explains the raise of participation in training with the raise of worker's specialization in the given field.

On the contrary, when provided training is viewed as an employer's investment, more advanced formal certificates might lead to less provision of training opportunities, as they make workers freer in their mobility and, therefore, increase the chance of their quit (Katz and Ziderman 1990). Besides, when an incentive to finance training is driven by already discussed goal of increasing the profitability of workers, it should be low-skilled workers who get the most raise in training to keep up with the increased employment standards. The absence of connection between formal qualifications and employer-financed training is derived from the credentialism, meaning that abilities and performance in the working life are of interest of the companies and success at schoolwork does not reflect them (Becker 1964, Piore 1968). Many of these abilities are taught informally [often self-organized], especially by the low-qualified (Münchhausen 2007). In order to draw hypothesis for the current research, statistics on the current professional training participation is needed to observe the given theoretical implication.

Various indicators could be used for measuring the individual skills' level. We use the examples of Adult Education Survey of 2014 (Bilger and Strauß 2015) to verify the discussed theoretical assumptions and create a comprehensive picture of the state of professional training

participation in Germany. It is important to mention that the statistics presented refers to all the participants of continuing vocational education, independently of the employment status (84% of them are employed). Measurement of the employee's ability through formal qualification is split onto different scales. Using school diploma or International Standard Classification of Education (ISCED) 1997, produces a direct ratio between the qualification level and training participation. Using German scale of professional qualification creates a slightly different picture. Participation in training is the highest among the graduates of technical colleges (Meister/Fachschule) – 58%, followed by high school((Fach-)Hochschule) – 48%, vocational school (Berufsfachschule) – 36% and those without formal qualification – 22%. A major variety of courses offered at German high schools in addition to the regular studies and/or broader job opportunities for the graduates might explain lower participation rates of this group. It might be stated that the statistics prognoses an overall direct ratio between the skills' (qualification) level and provided training, except high school graduates.

Another performance-related characteristic is *work experience*. Generally, more experienced workers need less training, as they already acquired a certain amount of skills previously (Grossberg and Sicilian 1999). Brunello (2001) finds lower rates of training provision for them, unless their skills become outdated. In this case, worker's age, discussed below in detail, would mark an upper border for worker's credibility. Both citied authors agree on the negative impact of the legal minimum wage introduction on training for more experienced workers.

The last section summarizes personal characteristics affecting training provision. We start with *age*, closely connected to the work experience, discussed in the previous paragraph. According to Becker (1964), younger workers both receive and invest themselves more in training because the return can be collected over a longer period of time afterwards. Besides, they are more interested and capable of learning, less tied to family responsibilities. For these reasons, training opportunities often justify lower wages for the working youth (Heyes and Gray 2003). Nevertheless, higher flexibility of this age group is connected to higher job mobility and, therefore, greater risks of quits (Leuven and Oosterbeek 2000). Although this often discourages firm human capital investments, those could be compensated by the employee's own ones in industry-specific rather than firm-specific skills. The compensation mechanism is also relevant for older workers. They are more confident of their abilities and aware of available training opportunities (Becker 1964), which first and foremost affects their own human capital investments.

Importance of age variable inclusion is crucial, as due to the absence of radical changes in employment rate [that have been observed in Germany], employment perspectives of young workers are of risk to be negatively affected (Abowd, Kramarz et al. 1999). With this respect, setting youth minimum wage has been a policy issue in several countries. For example, case of the Netherlands (Salverda 2010) proves its negative impact on training provision incentives. As the wage floor is raised with the age of workers independently on their work experience, employers are tempted to replace the employees with the younger cohort, which is cheaper than keeping older labor force and/or developing their skills. Generally low minimum wage for the youth stimulates them stay longer in education and discourages employer's human capital investments in the positions starting at this level. The following implications of the theoretical assumptions are provided by the statistics on further education attainment (Bilger and Strauß 2015). People aged 35-44 participate the most (45%) in training on the workplace in 2014, with similar indicators for the groups 45-54 years – 42% and 25-34 – 40%. Comparatively lower participation rate (27%) by the youth in the sample (18-24) is explained by the fact that the majority of them are not employed yet. The lowest value of the index in the oldest group is perfectly predicted by the human capital theory.

Further socio-demographic characteristic possibly affecting training provision is *gender*. Men are more likely to be selected for investment, as they are less time-constrained by family responsibilities and career breaks for maternity leaves, and, hence, associated with higher returns and lower turnover rates (Becker 1964, Leuven and Oosterbeek 2000, Bassanini and Ok 2004). Offerhaus and colleagues (Offerhaus, Leschke et al. 2010) hold the view that the absence of the impact of family status on training opportunities is explained by the described discrimination of females, carrying the most of its negative impact. Besides, authors claim that women attribute generally lower value to the further education than men. These theoretical assumptions are proved but slightly lower participation rate of women (34% in 2014) than men (40% in the respective observation period) in training on the workplace (Bilger and Strauß 2015). However, gender differences are related to the job characteristics (Leuven and Oosterbeek 2000). Women in Germany are reported to be more often employed in small firms and part-time jobs, both characterized by generally lower training provision (Offerhaus, Leschke et al. 2010). It is clearly reflected in the statistics. When controlling for the full-time employment, similarities grow, with 52% for men and 50% for women respectively; and tendency for raising participation for both genders (Bilger and Strauß 2015).With relation to the legal minimum wage introduction, empirical research predicts no impact of gender on the

change of training provision (Grossberg and Sicilian 1999). Therefore, the variable will be included into analysis under the control of job characteristics (already discussed above).

Widely discussed in different contexts, *migration background* has numerous implications in the labor market research. Natives usually enjoy relatively stronger labor market position in comparison to immigrants (Leuven and Oosterbeek 2000), who shall be equally covered by legal minimum wage regulations. A comprehensive overview of the barriers for further education of foreigners and persons with foreign background is performed by Öztürk and colleagues (Öztürk, Schuldes et al. 2014). They highlight the role of following factors in lower participation of immigrants in continuing vocational training: insufficient qualification [often caused by the fact that foreign qualifications remain unrecognized in Germany], low professional status and proficiency in German language. The latter creates an additional barrier when causing extra costs for suitable training organization (Bassanini and Ok 2004). Sense of discrimination for people of non-German origin is another subject of discussion by Öztürk and colleagues (Öztürk, Schuldes et al. 2014). When referring to the temporary labor migration, generally lower motivation for human capital investment could be observed (Becker 1964). German Education Report (Autorengruppe Bildungsberichterstattung 2016) differentiates in their measurement between first and second generations of immigrants. The first group participates much more often in professional education activities; whereas for the second group training serves as an instrument for labor market integration and professional consolidation. The subject gains further importance due to the European and German refugees' debate. Within this group not only gender-specific expectations of economic integration (lower ones for females), but traditional or patriarchal views of women's societal roles, are related to intention of obtaining further education (Haan, Kroh et al. 2017). To draw a conclusion for the listed theoretical assumption, statistics of Adult Education Survey (Bilger and Strauß 2015) is taken as a baseline. It indicates that Germans participate almost twice more often (39%) than foreigners (20%) in employer-financed training. Therefore, we expect further shortage of training for workers with foreign background in comparison to natives.

Although training is negotiated in terms of the firm strategy, most variation upon its provision is observed on the individual level. We have viewed them in three arbitrary built groups: performance-related (education, work experience); job-related (job tenure, job complexity, contract duration, form of employment) and personal (age, gender, origin). Each item causes major selectivity in training provision independently from the legal minimum wage. These characteristics are also in charge for the discrepancies between human capital investments of different groups of workers. The fundamental question that is going to be

answered in the current analysis is if the law introduction in Germany will contribute to the maintenance of these inequalities or becomes an incentive to invest in skills of those who previously remained disadvantaged.

Traditional critic of human capital theory is also applicable to the current overview, well summarized by Özturk and colleagues (Öztürk, Schuldes et al. 2014). First, employer and employee not always have the complete information about each other. Second, decisions are not always rational, thus they are often made in account to a very limited part of all the possible range of knowledge resources and consequences. Özturk and colleagues also mention signal and filter theory (Arrow 1973, Spence 1973, Seibert and Solga 2005), that take into account the uncertainty of decision-making processes. In the case of limited information about worker's potential performance, employer would address the observable indicators (perform objective selection (Becker 1964)). Educational background is mostly used as the standard in this case. Personal characteristics (age, gender, origin) might modify or diminish the impact of performance-related characteristics.

A tight connection between the described characteristics proves that employees are not distributed across positions randomly (Nedelkoska and Patt 2015), but inequalities are interdependent. This brings the theory of labor market segmentation into discussion (Reich, Gordon et al. 1973, Öztürk, Schuldes et al. 2014). Employees affected by the legal minimum wage would mostly belong to the "labor market for everyone" with low qualification requirements and promotion perspectives and partially to specialists' one. The latter is characterized with baseline formal qualification requirements, that are still applied to a wide range of firms. Whereas in the first segment human capital investments are almost rejected, they are also critically low in the second case, as knowledge can be applied in other companies. Low income returns provide little encouragements for individuals to invest in training themselves. The highest level of training provision is observed for the firm-specific labor market, where tight connection between employee and employer make these investments obligatory. Differentiation between skills, that the representatives of each market possess is a well-balanced transfer to the next paragraph.

2.3. Continuing Vocational Training

The current section provides the theoretical overview of the training concept. Due to the fact that this research is performed in terms of the labor economics approach, its limitation is a slightly simplified perspective on learning on the workplace. The latter is viewed as a human

capital investment and as one of the subjects of labor relationships, therefore, its process and content remain out of scope of this study. The purpose of this chapter is to conceptualize the training on the workplace for further operationalization and measurement. We proceed in the following way. First, we start with definition(s) of training. Second, we define types of training dependently on the provider and content and draw their reference to the central theoretical framework. Conceptual focuses of the current paper will be emphasized.

2.3.1. Definition

The major difficulty at the starting point is to find the universal concepts of training and its types. It appears problematic to match the vocabularies of different papers, as authors often match terms to their research goals. Further obstacle, is the subjectivity of German-English translation. Therefore, in case of the conceptual discrepancies of the terms used in the current work in comparison to the others, it is recommended to refer to the definition and not the word choice.

We start with the most general term of continuing vocational training (education). According to the EU Commission (Litster, Carpentieri et al. 2010), it is "a training process or activity which has as its primary objective the acquisition of new competencies or the development and improvement of existing ones, and, which is financed at least partly by enterprises for their employees, who either have a working contract or who benefit directly from their work for the enterprise, such as unpaid family workers and casual workers. The training processes or activities must be planned in advance and must be organized or supported with the special goal of learning". Following the vocabulary matrixes created by Litster and colleagues (Litster, Carpentieri et al. 2010) and European Center for the Development of Vocational Training (CEDEFOP 2008), we compare the term with related ones. Continuing vocational education is often analyzed as a part of lifelong learning activities, but the latter is overtaken not only for professional reasons, but social and personal as well. However, the statistics indicates the lower share of the latter for the whole range of further education activities, overtaken by the dominant majority (82% (Bilger and Strauß 2015)) for professional reasons. Continuing vocational education is also similar to the adult learning in the way that it happens after leaving initial (school and high school) education but does not include university-level or higher education undertaken in this time. Coverage of the costs by the employer is included already in the definition, similar Adult Education Study (Bilger and Strauß 2015).

However, it is important to keep in mind that employees might be overtaking the training on their own or search for other sources to cover the expenses. The importance of having a contract or profiting from the business activity of the company remains a valid limitation. Further conceptualization would be made on the basis of the skills' application fields.

2.3.2. Types of Continuing Vocational Training: Skills

It is reasonable to comment on differentiation of training upon the applicability of the skills within and outside the firm, as it is used as one of the basics of human capital theory by Becker (1964).

The basic idea of the author is to define if the skills acquired increase productivity on the current workplace more than in other firms (specific), only on the current workplace with no effect on employability anywhere else (completely specific) or to the same extent independently on workplace (general). The differentiation is important in order to emphasize the importance of investment in firm-specific human capital for the employers and general one for the employability of worker; and compare their investments in human capital. The critical point is to provide isolated objective measures of increase in productivity within and outside the firm, therefore the author of the classification states himself that most of the training is not completely general nor specific. On the basis of this critique, an alternative approach could be brought into discussion (Dakhli and De Clercq 2004). They differentiate between individual-specific (corresponds to the concept of general skills by Becker), industry-specific (intermediate value for the firm and individual) and firm-specific (completely specific skills of Becker are meant). This classification gives a more graduate understanding of the possible content of training and motivation of affected actors to support different types of human capital development.

In terms of the current research question, human capital and investment in it are viewed as cumulative values. It is not the content of training, but amount and its change that illustrate the effect of the legal minimum wage law. Both general and specific training improve individual productivity, which is the issue in focus due to the raising labor price. We also refer to the mentioned statement of Becker that strict differentiations between two types is conceptually impossible. For these reasons, the classification will be excluded from the current research model.

2.3.3. Types of Continuing Vocational Training: Organization Degree and Form

Another differentiation, widely used in the adult education studies, is the way further education is organized. On the one hand, it could be differentiated by the degree of organization, namely formal, non-formal education and informal learning. We follow the vocabulary provided by Litser and colleagues (Litster, Carpentieri et al. 2010). By formal education "learning that occurs in an organized and structured environment (e.g. in an education or training institution or on the job) and is explicitly designed as learning (in terms of objectives, times or resources) is meant. It is "intentional from the learner's point of view and typically leads to validation and certification". The latter is often embedded in the state qualification recognition system and might have duration restrictions. The similarity of the non-formal learning is its intentionality from the learner's point of view, but skills' development does not lead to certification. Most definitions agree on the presence of "student-teacher" relationship in information exchange, that are not obligatory physically present as a formal learning situation. The definition of the informal learning excludes intentionality of learner's perspective and formal organization in favor of contribution of everyday activities related to work, family and leisure. On the other hand, vocational training can be differently organized in terms of the location, namely on-the-job training [often used for the designation of the whole vocational education process], performed in the normal working situation, or off-the-job training, provided outside it.

Current classification is essential in terms of the measurement of learning transfer for different educational offers, competence and training development (Autorengruppe Bildungsberichterstattung 2016) and is less relevant for reflection on the initiatives for human capital investments. It could be argued that formal education is connected to higher initial costs, that still do not guarantee the direct productivity raise in the participating groups. Measuring further education activities will most probably exclude informal learning, which is often not perceived as one. Therefore, it might appear especially problematic for the studied labor market segment. As already stated in the first part of theoretical overview, performance in the low skilled tasks might gain substantial profit from informal learning and practice. The conceptual focus of the current research is to capture the intention to develop the skills of labor force, even though it is connected to additional costs, further raising due to the legal minimum wage introduction. Therefore, we follow the logic of labor economic approach studying the incidence and intensity of training as the indicators of the outcome.

2.3.3. Training Incidence and Intensity in the Quantitative Adult Education Research

Selecting supporting statistics for the current paper has not overcome several major problems of quantitative research in adult education. Measurements derived from different reports often produce major discrepancies in the conclusions (Kuwan and Thebis 2006, Wohn 2007, Widany 2009, Rosenbladt and Bilger 2011). Hence, it is argued that the differences in the operationalization, questionnaires, reference time frames, conceptual and methodological validity make individual surveys hardly comparable (Widany 2009). This becomes especially problematic when arbitrary classifications upon strictly separating characteristics are applied (e.g. general vs specific training; employer vs individually financed training). With this regard, the author concludes that in most cases operationalizing adult education is pragmatically rather than theoretically driven and, therefore, completely survey specific.

The discussion of the previous paragraphs has placed the focus of the current study on training incidence and intensity. In terms of the Input-Process-Output model (Klieme, Avenarius et al. 2007), it means the emphasize on the Input segment, namely education participation and participants. The latter is regarded as one of the most important indicators for the usage of training offers and, hence, expansion of lifelong learning as well as equality of chances for different socio-economic groups. In this way training participation becomes a characteristic of the population in general (Widany 2009). The author suggests measuring two components of the concept separately. For "training", already discussed classifications upon the content, organizational degree and form are relevant. We stick up to the drawn conclusions and proceed with the discussion upon the participation notion.

Three components are dominating in describing this concept: scope (participation rate), number of enrollments (training events) and volume (duration of participation) (Borkowsky 2000, Kuwan and Thebis 2006, Widany 2009, Rosenbladt and Bilger 2011). These statistics might be gathered from firms, providers or individuals; each creating a separate field to interpret the variables. Individual surveys are regarded as the most beneficial for representative studies for the sake of population-wide conclusions. *Participation rate* is the share (percentage) of persons who took part in further education activities within the observation period (Rosenbladt and Bilger 2011). With regard to the research goals, participation rate might be calculated separately for different types of training as well as cumulatively for learning activities of any kind, both referred to as *training incidence*. Although the indicator is of a central importance for the quantitative adult education research, its extension into intensity dimension is needed for substantive implementations.

Number of enrollments links the institutional perspective and individual attitude towards further education. In provider surveys, it serves as the measure of demand for different offers (Rosenbladt and Bilger 2011). On the personal level, it is an important indicator of learning behavior. Nevertheless, it should be interpreted with a major caution, as the definition of a training event is not universal but study-specific or assigned to respondent's own interpretation by default. This is connected to numerous potential pitfalls such as an equal count for a two-hour seminar and a semester-long program or inconsistency in splitting or uniting the basic and follow-on courses when calculating events (Rosenbladt and Bilger 2011). One of the authors' proposed solutions is a clear communication of an event definition to the respondents.

Another way to ensure careful measurement is inclusion of *volume* which is a total number of hours (or days) spent in further education activities within the observation period (Kuwan and Thebis 2006). Various indexes are derived from this measure. For structural analysis total volume of a group or population (sum) is mainly applied. Its absolute number has little informative value on its own, but is suitable for building growth models and observing developmental trajectories (Kuwan and Thebis 2006). Using training event as a unit of analysis usually involves calculating its average duration. For group comparisons measures of the average volume per person or per *participant*. Rosenbladt and Bilger (2011) limit the minimum of two overtaken training events within the observation period to be assigned to the latter. Taking into account an overall low rates of training participation within the observed labor market segment, we relax this assumption to one event per observation period.

There is no doubt that separate constructs deliver segmented information and a comprehensive approach requires inclusion of all of them as well as their interrelation. The measurements are not necessary following the parallel patterns of change and each one may portrait a different perspective on training participation of the selected groups (Kuwan and Thebis 2006, Rosenbladt and Bilger 2011). Rosenblat and Bilger depict the tendency of shortening the duration of training events under the raising participation rates and/or number of enrollments. This happens on the costs of reduction of their quality, as they report longer activities to be profoundly more beneficial for the learners.

In terms of the minimum wage research, little implicit attention is given to the interaction between both concepts. Whereas findings upon training incidence are relatively comparable, this is not the case for its intensity. For instance, firm-level research of the German case (Bellmann, Bossler et al. 2017), concludes the reduction of training intensity (number of workers trained) under the unchanged training incidence at the treated establishments. The extent to which these results are comparable to the individual level findings remains arbitrary.

Arulampalam and colleagues (Arulampalam, Booth et al. 2002) find a slight positive effect of the minimum wage introduction on both participation rate and training volume. Parallel trends have gained an empirical support either (Bassanini and Ok 2004). Group inequalities in training provision (gender, origin, company size etc.) are still more profound by training intensity. Besides, the widespread practice in the minimum wage research is to use one of the named indicators only. Therefore, the differentiated effect of the minimum wage introduction in different components of training participation remains uncertain.

2.4. Interim Conclusion: Summary and Theoretical Model of the Research

Table 1 below summarizes the presented theoretical arguments. Although the review has been done with the specific focus on the minimum wage labor market, they are applicable for any group of workers due to the embeddedness in the human capital theory. The table makes clear that the complexity of the impact of the minimum wage introduction goes beyond an increase in the employee's income to be invested in training and its decrease by the firm causing cut off on additional expenditures. Their interrelation and inter-compensation exclude straightforward prognoses. As positive externalities in the form of state and third-party subsidies cover both employer and employee training incentives and, therefore, do not reflect the patterns of the human capital theory, we do not make a specific focus on them. Under the minimum wage introduction, training incidence is most likely shaped by the firm investments and less by the individual ones. Positive externalities do contribute to the training incidence level in the affected group, but there is no indication for the change in their distribution according to workers' characteristics. Hence, we do define a specific central object for each argument as it is stated by the author, differentiating between individual, firm or both. The arguments are assigned to the author's quotations when being used as a theoretical argument and/or approved empirically. They are ordered according to their appearance in the text and no hierarchy in the contribution to the variance of the outcome is assumed. The arguments of different authors upon the same research subjects are marked with the hyphen.

Table 1. Predictors of Human Capital Investments under the Minimum Wage Introduction

Concept	Object	Positive impact	Negative impact	Absence of impact
Labor price increase	Firm	Uncompetitive labor market model (Cubitt and Heap 1999, Arulampalam, Booth et al. 2002, Acemoglu and Pischke 2003, Metcalf 2004)	Competitive labor market model (Becker 1964, Mincer and Leighton 1980, Hashimoto 1982, Schiller 1994, Brunello 2001, Neumark and Wascher 2001, Acemoglu and Pischke 2003, Haepp and Lin 2016)	Other adaptation strategies in response to the law (Agell and Lommerud 1997, Lang and Kahn 1998, David 2001, Fairris and Bujanda 2005)
	Worker	-Increased demand for the skilled labor as a motivation for the qualification upgrade (Cahuc and Michel 1996, Belman and Wolfson 2014) -Compensation for the shortage in the firm investments [competitive labor market model assumed] (Hara 2017)	Higher financial profitability of longer work in comparison to education (Belman and Wolfson 2014)	
	Both			More profound influence of other factors in the economic environment on human capital investments (Grossberg and Sicilian 1999, Fairris and Pedace 2004)
Firm-level characteristics				
Firm location	Both	East Germany: need to keep up with the technological standards of the West Germany (Fitzroy and Funke 1998)	East Germany: stronger affection by the law introduction (Mindestlohnkommission 2016)	Convergence in the regional development (Schiersmann 2007)

Business sector	Both	-Higher level of competition, profitability, labor market compositions, management expertise, access to the capital (Arrowsmith, Gilman et al. 2003) -Higher technological development of the branch (Bassanini and Ok 2004) -Higher knowledge intensity and qualification requirements within the branch (Schiersmann 2007) -Higher share of group and project work (Schiersmann 2007) -Positive externalities (Abramovsky, Battistin et al. 2011) -Lower substitutability potential in social and cultural services (Dengler and Matthes 2015)	Imperfect competitions on the market for skills and information failures (Abramovsky, Battistin et al. 2011)	
Company size	Both	Large firms: more advanced technologies, more qualified employees, lower labor turnover (Leuven and Oosterbeek 2000)	Small firms: -greater affection by the minimum wage introduction (Mindestlohnkommission 2016) -limited access to the capital and shortage of skilled labor force (Arrowsmith, Gilman et al. 2003, Heyes and Gray 2003)	

Individual level characteristics (Job-related)				
Job tenure	Both	- Shorter job tenure: major part of human capital investments at the beginning of the employment (Becker 1964, Grossberg and Sicilian 1999) - Longer job tenure: training provision limits labor turnover (Mincer 1988)		
Job complexity	Both	More complex jobs: -wider scope for improvement and returns (Wilkinson, Bacon et al. 2010, Nedelkoska and Patt 2015) -lower substitutability potential (Dengler and Matthes 2015)		
	Firm		Simple jobs: productivity improvement is of a higher need and lower costs (Leuven and Oosterbeek 2000)	
	Worker		Simple jobs: increased demand for the skilled labor as a motivation for the qualification upgrade (Cahuc and Michel 1996, Belman and Wolfson 2014)	

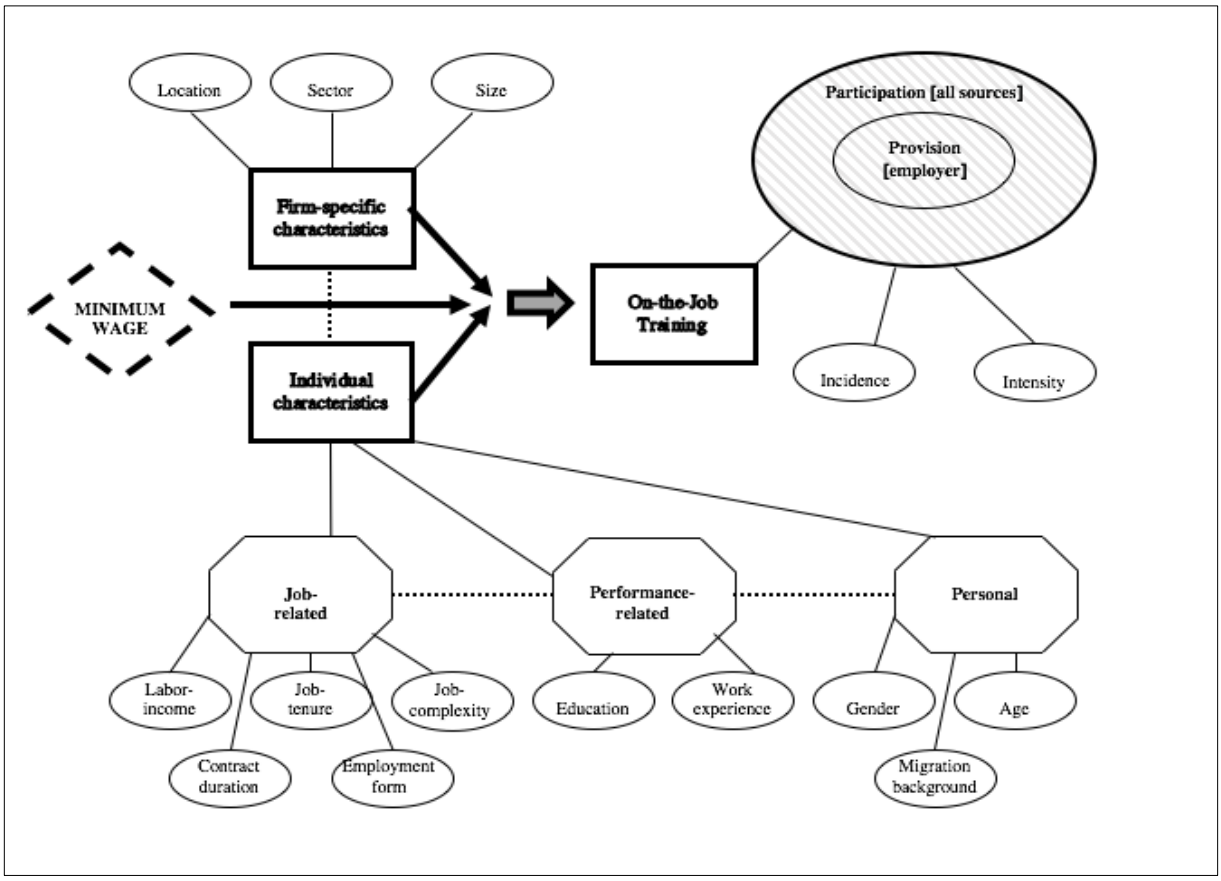
Contract duration and Employment form	Both	Human capital investments dependency on the amount of switching between activities (Becker 1964, Cole 1992, Wilkinson, Bacon et al. 2010)	Temporary contracts and/or part-time and/or marginal employment: -lower organizational commitment (Colquitt, LePine et al. 2000) -limited amount of employment time for training (Münchhausen 2007)	
Individual level characteristics (Performance-related)				
Education	Both	Highly qualified persons: higher returns and value of the investments (Becker 1964, Katz and Ziderman 1990)	Low qualified persons: longer learning process (Fouarge, Schils et al. 2010)	Credentialism (Becker 1964, Piore 1968)
	Firm		Highly qualified persons: higher risk of quits and mobility (Katz and Ziderman 1990)	
Work experience	Both	More experienced workers: outdated skills (Brunello 2001)	More experienced workers: less need for training due to the previously acquired skills (Grossberg and Sicilian 1999)	

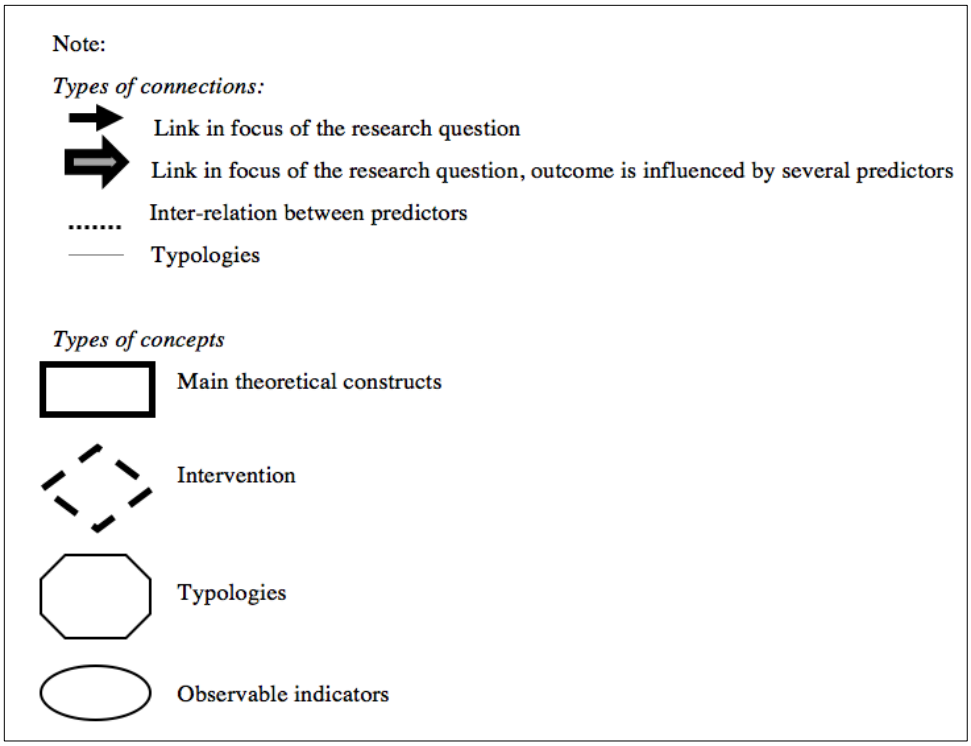
Individual level characteristics (Personal)				
Age	Both	Younger persons: -returns can be collected over a longer time period -more interest and capability of learning -lower tightness to family responsibilities (Becker 1964)		
	Worker	Older workers: higher confidence of own abilities and awareness of training opportunities (Becker 1964)		
	Firm		Younger persons: higher mobility and greater risk of quits (Leuven and Oosterbeek 2000)	
Gender	Firm	Men: lower time-constraints, higher returns and lower turnover (Becker 1964, Leuven and Oosterbeek 2000, Bassanini and Ok 2004)		
	Worker		Women: attribution of generally lower value to education (Offerhaus, Leschke et al. 2010)	
Migration background	Both	Natives: stronger labor market position (Leuven and Oosterbeek 2000)	Foreigners: language barrier (Öztürk, Schuldes et al. 2014)	
	Worker		Temporary migration: lower motivation for long-term investments (Becker 1964)	

Source: Chapters 2.2 and 2.3 of the paper

In order to visualize the described theoretical framework, Illustration 1 is provided below. It underlines the key concepts as well as connections between them, that will be in focus of the current paper. Minimum wage introduction is modifying the impact of firm-specific and individual characteristics on training opportunities. With regard to the labor market segmentation theory, the causes of inequalities on the individual level are interdependent with their outcomes on the professional and firm levels. As the dominant majority of job-related training is paid by the firm, employer-sponsored training is viewed as a dominant part of all continuing professional education. Following the labor market economical approach, training is conceptualized in terms of its incidence and intensity, both influenced by characteristics derived from the human capital theory.

Illustration 1. Minimum Wage and Training: Theoretical Model





Source: Chapters 2.2 and 2.3 of the paper

2.5. Potential Contributions of the Current Study

2.5.1. Existing Research Gaps

The main part of the chapter has defined the existing theoretical framework and contemporary state of research. This passage deals with its current gaps to draw the implication for the contributions of this analysis.

In terms of the baseline link between minimum wage introduction and training there are three theoretically established interpretations. Negative impact, derived from the competitive labor market model, is gaining the growing body of evidences from the studies in the United Kingdom and United States. Both countries represent liberal welfare state (Esping-Andersen 1999), therefore, their experience could be only partially applied for the German labor market. Institutionally comparable French case delivers an opposite positive prognosis of the production process optimization through multiskilling as an outcome of the law. Due to the absence of the straightforward answer to the law outcomes with this respect, empirical research is valuable. This is both vital within the body of studies of the minimum wage consequences and evaluation of the newly introduced policy in the German context.

Further point to be underlined is the inconsistency and fragmentation of findings due to the usage of different level of analysis. Performing study on the establishment level is beneficial

to observe training as a part of firm's strategy. Nevertheless, major variation of its provision is still placed among workers. Hence, we believe that it is more reasonable to use them as units of analysis controlling for firm-level characteristics. For this purpose, human capital theory is applied to draw main logical connections and define central concepts of the thesis. It has been well established within the scientific community and verified by numerous empirical examinations. Its basic statement of choosing the human capital investment that brings the most profit and least risk is proven by the consistency of findings controlling for various individual characteristics. Nevertheless, a gap [being mostly approached from a managerial perspective] exists in the incorporation of labor market segmentation into human capital theory. Due to the growing complexity of the employment relationship and their forms, it remains unclear if the same patterns regulate human resources development for all groups of workers. Current research performs an attempt to contribute to this field from the perspective of social sciences in the affected by minimum wage introduction segment.

In terms of the research on job-related training, the study extends the understanding of its provision in Germany under the labor economic approach. Besides, statistics available for now, do not provide a differentiated dynamic picture of causal relationship between predictors with the focus on workers who are directly affected by the law. Little synthesis is also done for the findings upon training incidence and intensity in the observed workers' segments. Special attention should be paid to employer-financed training, as it constitutes the majority of further education activities in the country, on the one hand, and indicates the potential for production process optimization and consequential general economic development, on the other hand.

To sum it up, despite relative consensus upon the theoretical guidelines of minimum wage consequences and training provision linked to it, the topic is only being developed in the German context on the empirical basis. It is possible to draw approximate predictions only, whereas their specification remains an empirical exercise to explore. At the current stage, the findings do not overcome the limitations of descriptiveness to be further developed in a longer observation period. This research makes its contribution to forming a basis for that at the current stage.

2.5.2. Research Objectives

Taking into account the defined research needs and potential contributions of this study for them, following major research objectives are derived:

- Create a comprehensive understanding of the impact of the legal minimum wage on the training for the affected workers in Germany.
- Specify the effects with regard to contextual and individual-level predictors of human capital investments.
- Differentiate the effect of the minimum wage introduction and indicated predictors with regard to different indicators of training participation.

Specific steps towards them will be discussed in detail as the parts of the research design.

2.5.3. Hypothesis

In order to draw a transitional conclusion to the next part of the paper following hypothesis are formulated on the basis of the reviewed theoretical framework:

- Introduction of the legal minimum wage reproduces and deepens existing inequalities in training incidence and intensity of the affected workers.
- On the contextual level, lower training participation is observed in the most affected sectors (Retail, Accommodation and food service activities, Transportation) and in small companies. Its higher rate is attributed to the East German establishments in comparison to the West ones.
- The differentiation between workers for investments in their human capital remains consistent with the outlines of human capital theory:
    a) In terms of the job-related characteristics, higher job complexity, permanent and/or full-time contracts have positive impact on training provision, whereas the relation of the latter two to labor income and job tenure is reverse.
    b) For performance-related characteristics, education and training remain complements. The connection of the latter to work experience is opposite.
    c) Personal characteristics affect training participation in the following way: younger age, male gender and absence of migration background increase the training chances of an employee.

Operationalization and measurement of each item as well as sample selection for testing these predictions will be described in the next chapter.

2.5. Conclusion

We have provided the necessary theoretical framework for answering the research question of the impact of legal minimum wage on continuing vocational training of directly affected workers. Several labor market models have been revised to derive predictions upon the general nature of the connection. Human capital and labor market segmentation theories has been applied to emphasize the differentiation of human resources within the investment approach. Discrepancies on definitions and typologies of continuing vocational training (on-the-job training), has been discussed and incorporated into the chosen labor economic perspective. Research gaps in the existing literature have been exhibited and translated into the current study objectives. Acknowledgements of the current state of the topic create sufficient basis for hypothesis formulation. These contributions are transferred to the Research Design chapter.

Chapter 3. Research Design

3.1. Introduction

The third chapter approaches the major elements of the current research design in detail. It is structured as follows. Its first part deals with the working dataset and basic information upon it, proceeding with the sample construction and treatment assignment. Then we describe the measurements of the dependent and independent variables. In the third part, we establish the methodology of the analysis and its implications for the research question. The last section summarizes and concludes.

3.2. Data Selection

On the account of arguments discussed in the literature review, training provision and participation with relation to the minimum wage is reasonable to study on the individual level. It is necessary to cover both rate and trend patterns. The major research ambition in the policy evaluations is to establish causality of the observed intervention. At the same time, predictors that are stable over time have to be controlled for. These research needs are best fulfilled by the usage of panel data (Andreß, Golsch et al. 2013). They are especially valuable for studying the dynamics of adjustments and changes of individual standards through the development policies and interventions (Baltagi 2005). From this perspective, the current research presents the prior step in capturing the outcomes of the minimum wage, whereas short time-series dimension remains a problem. The German Socio-Economic Panel (SOEP 2014-2016) has been chosen due its recognized survey standards and comprehensive coverage of the topics of interest, both pointed out below.

SOEP is a longitudinal study, carried on since 1984 in West and 1990 in East Germany, covering 30.000 respondents in 11.000 households (Haisken-DeNew and Frick 2005). It follows the micro-economic approach under the inclusion of sociology and political science variables to examine the changes in living conditions in the country. The thematic fields of education, training and qualification, labor market, earnings, income and social security, that are of the central importance for the chosen research question, belong to the major focuses of the panel. Sampling has been performed on the multi-stage random basis using random-walk selection of households. Interviews are done with all their members through pretested

questionnaires. To minimize the panel effect, equivalence of survey instruments is maintained under continuing adaptation of the questions to the current situation (Andreß, Golsch et al. 2013). Their separate versions are developed for households and individuals; in addition to those covering further topics of interest for family, children and immigrant surveys.

Numerous measures have been established to account for representing the target population of the German residents over time. To reflect its natural changes, follow-up concept is carefully maintained through inclusion of the newly born or moved-in household members, as well as following up those who split off. Apart from response refusals [to be prevented by numerous measures of panel care], movement abroad and death are reasons for panel dropouts. Last but not the least, the immigrants are oversampled, as well as East Germans to gain the sufficient number of cases for analysis of these samples on their own. Nevertheless, the number of observations in these special groups that are difficult to achieve remains limited for multilevel analysis enabling further within-group differentiations.

The German Socio-Economic Panel is an established instrument in the country's adult education survey, in spite of the fact that the latter is not its prior thematic focus. On the one hand, multiple topics covered in the survey allow for broadening the paradigm to economic and social science perspectives on continuing vocational education, as well as interdisciplinary approach. The opportunity to compare a major variety of socio-demographic groups upon their training participation enriches profoundly the education policy research. On the other hand, multi-themes questionnaire is beneficial for comprehensive coverage of training concept also on its own. People who did not take part in it and/or have no interest in the field, are not in danger of drop outs, as in happens in the adult education surveys (Schiersmann 2007, Widany 2009). Nevertheless, the absence of the educational focus comes on the costs of the shortcomings in the available measurements. First, this is reflected in the fact that only basic ones are collected. Second, the operationalization of continuing vocational education concept by respondents on their own is taken for granted and the information is gathered upon the training measures considered as those by participants on their own (Rosenbladt and Bilger 2011). Despite these acknowledgements, we advocate the selected dataset as one of the best contemporary available research solutions to approach minimum wage and adult education fields simultaneously.

We use the datasets of survey years 2014-2016 to make pre- and post-comparison as well as observe [partially] the latency of the changes and dynamic of adjustment. Earlier datasets could not be used due to the absence of comparable dependent variables of further training participation in the questionnaires. It is important to notice that the information on the

dependent variables is measured for the previous year. We do account for that in the interpretations but keep using the wave index for marking the variables to avoid misunderstandings. It has been acknowledged that the law has increased employers' uncertainties and expectations of the wage costs to become a problem already prior to its introduction (Bossler 2017). The author provides a range of theoretical and empirical evidences for both to influence investment and employment decisions. This implies that the effect of the minimum wage introduction is reasonable to analyze already prior to the 1st of January 2015. Bossler starts the chronology of the minimum wage introduction with the Federal election on 22nd of September 2013 followed by signing the coalition agreement that mentions the law on the 14th of December 2013. Hence, we use the three-year comparison (all waves pairwise) to observe the latency in the findings and short-run impacts on a descriptive basis. The chronology is visualized with regard to the treatment assignment in the end of this chapter with regard to other elements of research design.

As the current paper is based on the secondary analysis with established measurements' validity and reliability, data collection and variable construction are discussed only briefly. Measurement error is further minimized within the study design through repeated data collection and stable characteristics of research units (Andreß, Golsch et al. 2013). The work of SOEP Team have been incorporated on all stages of sample and variables selection by using a large share of already generated variables (Deutsches Institut für Wirtschaftsforschung 2017). The next chapter gives an outline on this issue.

3.3. Measurement of Variables

Translating the theoretical concepts into variables is of the central importance for the strength and quality of a quantitative research. Nevertheless, there is no universal standards to be overtaken. As pointed out by Haepp and Lin (2016), discrepancies in the minimum wage outcomes research are often caused by different ways of operationalizing the key variables. Therefore, we maximize the advantages of already established SOEP indicators; which comes at the cost of matching the theoretical concepts to already measured items. Choice and recoding the variables to fulfill the current research needs is made transparent. Its guidelines are summarized in the Table 46 of the Appendix.

Considering the arguments for the reasonability of introducing multiple measures of training participation, we provide four indicators for the outcome. Survey instrument itself

contains the operationalization of the concept. *Training incidence* and derived *participation rate* is meant as a binary response of participating in any type of further professional education (German: "berufliche Weiterbildung") at any cost within the previous year. *Training intensity* includes two components: *number of enrollments* (total number of training events within the previous year) and *training volume* (their total duration in days). The relevant critic discussed in the first chapter, remains valid for the listed variables either. *Employer-financed training incidence* is a binary variable, where a positive outcome indicates partial or complete coverage of training costs for one, the most important training measure by the current employer (the chosen formulation has been needed for annual data comparability). Hence, there is no possibility to differentiate training solely financed by one of the sources. A short response upon possible critic towards uncertainty of the costs' share should be given at this point. As demonstrated in Adult Education Survey (Bilger and Strauß 2015), the dominant majority of the further education activities is financed by the employer. Following the logic of human capital investments (Becker 1964), their individual capability is related to one's income; therefore, they are going to be even lower in the observed labor market segment and are possible to be regarded secondary. Besides, we have to keep in mind that subjective definition of the most important training measure is not free of bias to represent the employer's intention to invest in training of their workers. Whereas training incidence and intensity are measured for the three observation years, the measurements of the employer-financed training incidence are available only for 2014-2015 survey years.

Most of the explanatory concepts are available as SOEP generated variables (Deutsches Institut für Wirtschaftsforschung 2017). The firm-level variables include its location, sector and size. *Firm location* is operationalized by a dichotomy of East (including Berlin) and West Germany. There is no evidence in the reviewed literature for the need to analyze Berlin separately. Following the example of the Federal Employment Agency and Federal Office for Statistics (Mindestlohnkommission 2016), we assign it to East Germany. For the measurement of *business sector* SOEP uses Statistical Classification of Economic Activities in the European Community (NACE) (Eurostat 2017). First, we recode the original responses up to the highest industry level. Second, we use a cut point of 20 cases pro category as sufficient to draw representative conclusions (Babyak 2004) including the sector in the analysis on its own. The branches that do not meet this requirement create the "Other sectors" category. As the result, following branches will be observed separately: Manufacturing; Wholesale and retail trade, repair of motor vehicles and motorcycles; Accommodation and food service activities; Transportation and storage; Administrative and support service activities; Education; Human

health and social work activities. *Company size* is measured as a generated categorical variable. The same as other ordinary variables in the current research model, the predictor will be included in the model using category dummies to observe for the patterns of change in the outcome for each one individually. Although the ranking of the variable reflects its magnitude, non-linear trajectories can be captured including categories separately (Wooldridge 2012).

Explanatory job-related variables (individual level) are incorporated in the analysis in the following ways. *Labor income* is measured as generated current gross labor income for all respondents who are employed in the main job using imputation by non-response (Deutsches Institut für Wirtschaftsforschung 2017). Inclusion of the minimum wage variable in this case would have better reflected the theoretical assumptions but is not reasonable due to the high rate on data loss. For those respondents who did not have minimum wage established before 2015 its value is missing and no change of it could be quantified. *Job tenure* is measured as a generic metric variable indicating the length of stay with a firm. For *job complexity,* subjective evaluation of the training required for the work is used. The shortcomings of this operationalization have been approached on the theoretical level. The time for collecting possible revenues from the investment could be expressed through contract and employment types. For the *contract duration,* we shall differentiate between permanent and temporary jobs. As *employment forms* relevant for the current research question, we separate full, part-time and marginal ("mini-job") employment.

Education is included in the model as an indicator of worker's ability. As discussed in the theoretical overview, no consensus has been achieved upon its link to training provision. In order to account for both *formal qualification* and *length of studies*, these patterns shall be separately controlled by two variables. For the first concept, ISCED-2011-Classification variable has been applied and recoded (See Table 46 in the Appendix) to ensure that each category has enough observations for drawing representative conclusions. For the second concept, SOEP generic metric variable indicating the amount of education or training in years is used. *Work experience* is measured by the total number of years of employment. As there is no possibility to control for the work experience which is relevant for the current occupation, an equivalent value of work experience of any kind has to be assumed. In the case of continuous employment history, which does not constitute a requirement in the sample construction, the variable is going correlate with the worker's *age*. This shall be accounted for in the multicollinearity diagnostic. Similar to further individual characteristics of *gender* and *origin,* it will be included into the research model, not only as socio-demographic characteristics but as the one highly relevant for the human capital theory.

The function of *time as a variable* has not gained a universal definition and depends mainly on the research question. It is either separated it as a predictor on its own (Field 2009) or recommended as a control notion for period effects but not as a causal factor on its own (Allison 2009, Andreß, Golsch et al. 2013, Giesselmann and Windzio 2013). Wooldridge (2012) recommends using time trends to omit spurious regression problem, when relationship between two variables are caused by the growth of both over time. As the panel used in the current paper is equally spaced, year dummies will be included in the models as indicators of the change in dependent variables at a given time point. For detailed description of the described measurements of the concepts, please refer to the Table 46 in the Appendix [Original SOEP variables, recoded values and value labels].

Dependent variables are all time-varying. Independent variables are quasi time-constant, as both their general effect and one of their change might affect the variables of interest. For example, as claimed by Berge and colleagues (Berge, Kaimer et al. 2016), structural changes in employment forms took place due to the minimum wage introduction. At the same time, each employment form itself has its impact on training provision within the human capital framework. Similar assumptions could be addressed to every predictor, as employees might be switching between fields of work, gaining additional degrees and years of work experience and etc. As the observation period is relatively short and this kind of changes is unlikely to happen instantly after the law introduction, we have valid reasons to treat the independent variables as time-constant and study their general effect. We show that both within- and between-variation in the variables is present (Table 54 in the Appendix) and a combined analytical solution is needed. For that, we first approach the statistical portrait of the sample in the next chapter.

3.4. Target Population and Sample

The target population of these analysis are all the employed German residents who are affected by the legal minimum wage introduction through the actual increase of the latter. An employee is defined by the Eurostat definition (2017) as "a person who has a contract to carry out work for an employer and receives compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind… The contract is an agreement between an enterprise (the employer) and a person (the employee), which may be formal or informal, normally entered into voluntarily by both parties…". Following this definition, the sample

construction after prior data retrieval and matching for all persons participating in the survey in these years is performed on the basis of PGSTIB generated variable of the occupational position (Deutsches Institut für Wirtschaftsforschung 2017). We follow the recommendations of Andress and colleagues (Andreß, Golsch et al. 2013) maximizing the efficiency of estimates by the largest available number of cases and use an unbalanced panel, relaxing an assumption of a continuous employment history. Therefore, spells (an individual remains in the sample if being employed in one of the survey years) of following statuses are excluded: not employed, pensioner, in education, military/community service, registered unemployed, self-employed and sheltered workshop. The latter are excluded while employers of these establishment might receive additional training subsidies and, therefore, are not incorporated into traditional labor relationship model.

At the second step of sample selection, affection by the legal minimum wage introduction is to be defined. The reviewed theoretical background points out the complexity of separating the adaptation practices from each other as well as the widespread incompliance. Therefore, it is reasonable to believe that the change in training provision takes place as an outcome of an increase in labor costs. Those workers who are eligible for the law and still do not receive the stated wages are not going to experience the change in training provision either, as for their employers the labor price in its absolute numbers remained the same. Further complication is to calculate the sum of the minimum wage through the labor income and working hours; separating additional benefits and bonuses in their monthly dynamics; actual and subjectively estimated work duration. Therefore, we formalize our analysis to measuring the change in the minimum wage through the branch tariff agreement. These assumptions result in the following operationalization of the treatment and control group.

For the sample construction, we use the binary affection information of the survey year 2015. The magnitude of affection is to be controlled in the models by the inclusion of the labor income variable. We assume that a person is directly affected by the law introduction when having no minimum wage in their salary or the one that is below 8.50 Euro per hour in the 2014 and changing into the wage of 8.50 Euro and higher per hour in 2015. Filter questions 104 and 105 of SOEP questionnaire of 2015 (Deutsches Institut für Wirtschaftsforschung 2015) and own calculations have been applied for this purpose. Several adjustments are made at this point. People who face a profound income increase in the time when the law has been introduced (15 persons in the sample) are defined as unaffected, as this change is unlikely to be attributed to the legal minimum wage but to specific adjustments and regulations [10.50 Euro per hour has been arbitrary defined as a cut criterion, as the last value indicating a lower than 25% income

increase]. People whose minimum wage has remained below 8.50 Euro in 2015 [respondents facing exceptional transitional regulations or illegal non-compliance practices] are defined as those unaffected by the law, as both concepts are the subject of a research on their own and are out of scope of the current analysis. As mentioned by Caliendo and colleagues (Caliendo, Fedorets et al. 2017), the universality of the policy limits significantly potential strategies for evaluating the law impact. Following the methodology proposed by the Minimum Wage Commission (Mindestlohnkommission 2016), we use the concept of anticipatory wage adjustment to construct the control group. It shall be constituted from those employees who have got the minimum wage of 8.50 Euro an hour already in 2014 and kept it for 2015. The latter cannot be defined neither as those completely unaffected by the law nor as those indirectly affected. Therefore, both joined and differentiated analysis of the experimental and control groups is needed for generating the robust findings.

The number of observations in the control group is distributed in the following way: 166 in 2014, 190 in 2015, 150 in 2016. The majority of them (136) participated in all the three survey waves and 44 – in the two survey waves. For the treatment group, there are 357, 442 and 361 units respectively, 302 of which are available as a strongly balanced panel, and measurements at the two times points – for 114 respondents. Control for descriptive statistics and statistical significance of their differences (Tables 49-53 of the Appendix) proves their comparability and similarity. West Germans are dominating in the sample due to the SOEP sample structure despite the fact that East Germany actually faces a more profound wage increase with regard to the law. Other characteristics of the sample go in line with the general tendencies described in the affected labor market review of the previous chapter. The employers of the constructed sample are concentrated in the following sectors: Manufacturing, Wholesale and retail, Transportation and storage, Human health and social work activities. There are also no statistically significant differences in groups' distribution across companies of different sizes.

One cannot define the employment of the persons affected by the law, as completely unstable and/or non-traditional, as permanent contracts and full-time work are the prevailing. Whereas no statistical dependence exists between treatment assignment and contract duration, it is present by the employment form. The higher share of part-time and marginally employed persons in the treatment group indicates the fact that anticipatory wage adjustments have taken place mostly by the full-time workers. The reverse explanation is possible either: wage increase causes employment status to change. The latter has already been discussed among the employment outcomes of the minimum wage law. Overall decrease in the share of part-time

and marginal jobs is also clear from the presented annual descriptive statistics. Similar pattern is observed by the job complexity. Consequential upgrade in the task requirements due to the anticipatory wage adjustment as well as selectivity of candidates for the wage increase according to the knowledge intensity of the performed jobs could be both sources of the observed statistical differences in the variable due to the treatment assignment. It is also notable that the studied work segment is not exclusively unskilled: approximately the half of the workers in both groups are doing work for which at least vocational education is needed. Their share has also grown further within the observation period on the cost of decrease in the percentage of simple work.

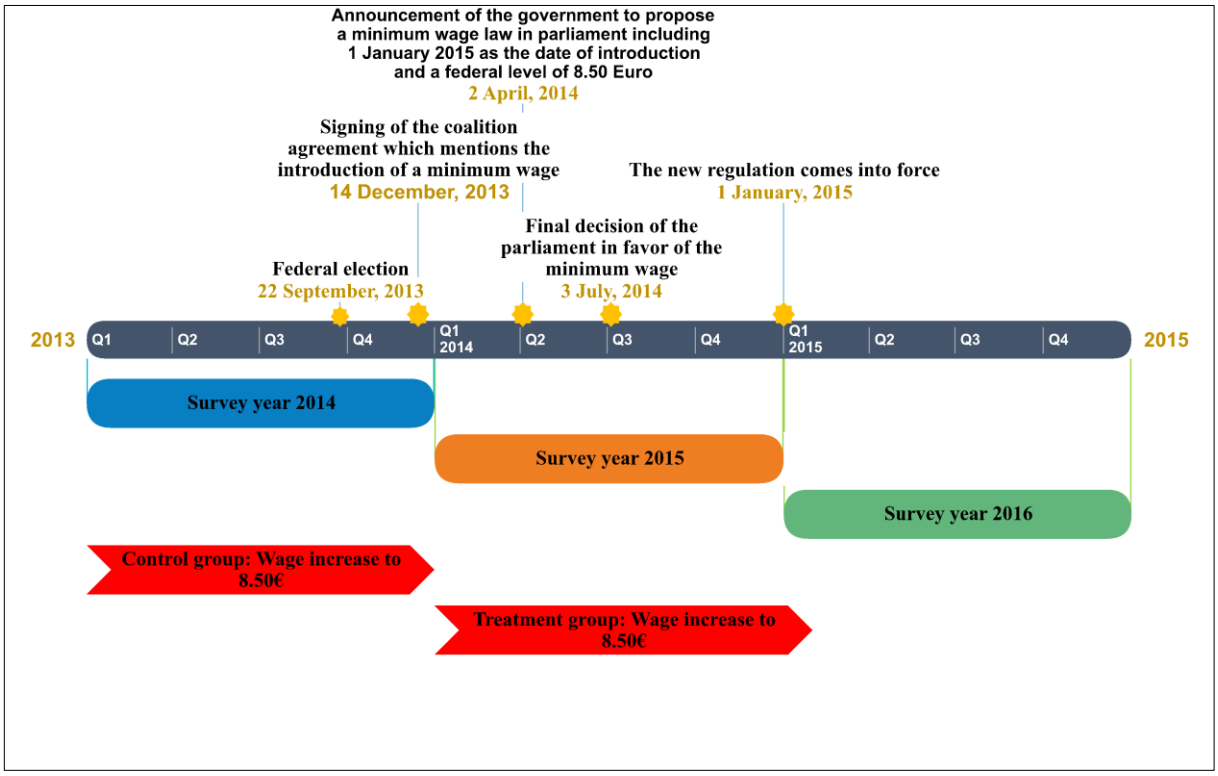
This claim is supported by the values on formal qualification and education duration. The examined workers mostly have upper-secondary education. Nevertheless, this is still followed by almost equal shares in the groups of lower secondary and grades below; and bachelor (or equivalent) degrees. Statistically significant differences are observed neither by the duration of education nor by the highest achieved formal degree. The affected segment is not an entry labor market either: the shares of the newly established relationship (up to one year) and young professionals (less than 5 years of work experience) are low in comparison to the others. Nevertheless, T-test results show that the employment relationships of the members of the control group are significantly longer than the ones in the treatment group. The previous argument also implies the low share of young people (17-24 years old) in the sample. The age does marginally affect the selection probability on the basis of employment status, because persons below 24 are likely to be in education. No statistically significant differences are found between groups on the gender or migration background basis.

As minimum wage research refers to the field experiments under the labor market intervention, the design of the current research is not free of shortcomings. Despite the existence of comprehensive datasets with the sufficient number of the control variables, randomization is impossible in this case (Hammerschmidt, Sagebiel et al. 2017). This is made clear in the following example. Despite an increase in the gross labor income in an annual perspective, it remains higher in the control group. The limitation behind is the fact that wage distribution is regulated by the variety of factors (Caliendo, Fedorets et al. 2017), that are impossible to simplify by a single theoretical model. The assumption behind a current design is the fact that wage differences between two groups are explained by no other factors than the anticipatory wage adjustments. The latter become possible due to already described public policy discussion prior to the law (Bossler 2017). Nevertheless, we have indicated the range of differences in

work-related characteristics that constitute both valid causes and outcomes of the wage differentials settings.

Illustration 2 below summarizes the main outlines of the current research design within the calendar of the main events in the minimum wage implementation in Germany. It also shows the reference time frame for measuring the key dependent variables and the intervention.

Illustration 2. The Current Research Design within the Chronology of the Minimum Wage Introduction in Germany



Source: Chronology listed as Bossler (2017), Chapters 3.2-3.4 of the paper

3.5. Methods of Analysis

Following Giesselmann and Windzio (2013), we apply the following criteria for choosing the appropriate method of analysis: nature of the research question and variation of independent variables, verifying both by a formal statistical approval. As the dependent variables are measured on different scales (metric and nominal) within different time spans (2014-2015 and 2014-2016), separate selection of methodology is needed to achieve the

comprehensive coverage of the research question. The models still have to remain equivalent and incorporate the fact that some outcomes and predictors refer to different biography points. The discussion of the methodology provided below is not claimed to be a detailed description of each analytic procedure but aims to explain its benefits in the current methodological solution. Descriptive statistics will be guiding at the starting point for each analysis. All the calculations are performed using Stata software and their syntaxes are made transparent.

For the analysis of the change in incidence of employer-sponsored training (2014-2015) and one of the training participation (2014-2016) *Random Effects Logit Model* [Stata: xtlogit, re] will be applied. For a binary dependent variable, logistic regression is reported to provide more accurate results than a linear probability model, as the estimation is derived from the relation between an event and a complementary event under the influence of predictors. It does not rely on the assumptions of homoscedasticity, normality of distributions and linearity of relation between outcome and predictors (Giesselmann and Windzio 2013). We proceed with the argumentation of the book in the choice of the random effects option. In terms of the semantic interpretations, random effects model accounts for the general effects of the predictors rather than their change. It is especially beneficial for studying the incidence of employer-financed training within 2014-2015 survey years, when the law is unlikely to cause rapid massive changes in the explanatory characteristics of the employers. Therefore, we cannot rely solely on the information coming from the observations changing them. Instead we focus on the time-constant predictors of the variation in the training incidence and intrapersonal rather than within-observation comparison. The pattern of change will be incorporated using time predictors in the model, as well as comprehensively approached through descriptive statistics.

Although the chosen method refers to cross-sectional scientific issue, it models the panel data structure and, therefore, accounts for overly conservative correction of standard errors after the estimation (Giesselmann and Windzio 2013). Production of optimal estimates for unit-specific intercepts, possibility to differentiate between error components, usage of unbalanced panel and measurability of the effect of time-constant variables refer to further advantages of the random effects models (Allison 2009, Wooldridge 2012, Andreß, Golsch et al. 2013, Giesselmann and Windzio 2013). In other words, the chosen command is reported to produce the most comprehensive conclusions due to the usage of both longitudinal and cross-sectional information from the data. In the case of logistic regression, random effects option is especially reasonable, as no observations have to be excluded; whereas competing Fixed Effects Logit Model would have kept only those units, for which the change in the dependent variable took place (Giesselmann and Windzio 2013).

Shortcomings of the method also have to be pointed out to draw the potential limitations of the upcoming findings. The dependence of measurements and errors within observations, which ensures control for unit-specific heterogeneity in fixed effects models, causes an inference statistical problem for random effects ones (Giesselmann and Windzio 2013). The latter rest on an assumption of model specification, meaning that all the necessary variables have been included in the regression and no correlation between observed and unobserved variables exists; which is, however, practically claimed to be almost unrealistic (Allison 2009, Giesselmann and Windzio 2013). To advocate the method at this point, all the predictors having a potential impact on the outcome within the theoretical background, have been incorporated into the analysis.

Last but not the least, is a formal statistical verification of the method choice by the *Hausman test* (Allison 2009, Wooldridge 2012, Giesselmann and Windzio 2013) to check if the estimates of two identical specifications performed on two different procedures, show statistical differences. Although in the case of logistic regression the test is performed on the different samples due to observation exclusion by the Fixed Effects Model, this does not cause a problem, as the comparison is made between coefficients (Giesselmann and Windzio 2013). As the test does not produce significant results (Tables 55 and 56 in the Appendix), we conclude upon the absence of the correlation between unit-specific effects and time-varying variables of interest and treat random coefficients are undistorted.

Incorporating mentioned limitations of the methodology, selected for the entry stage of the analysis, we proceed with modelling the longitudinal nature of the research question upon the change in training intensity through *First Differences Regression*. As both dependent variables [total number of overtaken training measures and total number of days within which they took place; for both within the previous year with reference to the survey] are metric and available at three measurement points, less formal statistical shortcomings are applied in comparison to a binary variable. We apply the computations of Allison (2009), constructing separate OLS equations for the first differences in 2014-2015, 2015-2016 and 2014-2016; and proceed with the GLS estimator in the population-averaged model to combine the first two [Stata: xtreg, pa]. The suitability of the method for policy analysis, program evaluation and obtaining causal effects due to its embeddedness in the experimental logic is widely recognized (Allison 2009, Wooldridge 2012, Andreß, Golsch et al. 2013, Giesselmann and Windzio 2013). The selected dataset also complies with the formal statistical assumptions for method application manifested by the above-mentioned authors.

The basic idea of First Differences Regression is modelling the instantaneous change in the outcome under the change in the predictors (change scores instead of absolute ones). This implies that the intrapersonal differences in the level of training intensity will not be incorporated allowing to interpret the effect of explanatory variables as actual and immediate (attributed exclusively to the event) (Giesselmann and Windzio 2013). Controlling for the unobserved heterogeneity refers to the further major advantages in this case. Unobserved unit effect correlating with the worker's training participation may include average employee ability, productivity, learning initiative and motivation, which, according to Wooldridge (2012), are unlikely to change over a short observation period.

There are several shortcomings of the method, which are substantially compensated by the two-stage research design of the current paper. An interpersonal variation is fully incorporated in the random effects models of training participation. Although estimating direct impact of the predictors is highly beneficial for before-after comparison, it remains problematic for the events that happen rarely in the individual biography and, therefore, cause gradual changes following a longer pass (Andreß, Golsch et al. 2013, Giesselmann and Windzio 2013). Whereas employment type might change quite often, this is not the case for the education. Although the law might theoretically motivate workers for obtaining additional qualification in the fear of losing the workplace, the effect of initial education is more likely to be attributed to the persons first completing their education. Hence, the impact of this variable along with time-constant characteristics (gender, migration background) will be treated as unobserved unit effect and cannot be quantified in terms of the model.

Following the recommendations of Adress and colleagues (Andreß, Golsch et al. 2013), we avoid estimating the effect of age in the model, as it is a linear function of time. Nevertheless, we advocate the inclusion of work experience and job tenure variables, to control for possible previous unemployment spells and/or job changes. First Differences Regression method also rests on the assumption that all time-varying variables affecting the dependent variable [other than those being a linear function of time] are included in the model. It has been ensured by the comprehensive review of the minimum wage outcomes in Germany, as well as by the assumption of the strict exogeneity of regressors. Self-selectivity of the respondents might become a further problem, as the regression equation operates on a strongly balanced panel (Wooldridge 2012, Giesselmann and Windzio 2013)

As the current research seeks to make representative statements upon the target population, a notice on weighting is needed. The variables of interest (training participation and provision) do not affect the selection probability. Hence, following the strategy proposed by

Andress and colleagues (Andreß, Golsch et al. 2013), we do not use weights in the analysis but control for the variables of gender, age, education and immigrant status that influence response probabilities. Together with the previously described implications, this rounds up the methodological solution of the current paper.

3.6. Conclusion

The current paper is based on the secondary data analysis within two methodological dimensions. The necessity of longitudinal design and specific benefits of the German Socio-Economic Panel have been critically approached with regard to the needs within the current research question. Shortcomings of the secondary data analysis are compensated by the validity and reliability of established measurements selection procedure and have been made transparent. Sample construction as well as treatment assignment have been introduced into consideration of existing empirical and theoretical limitations. The methodological solution implies the combination of modelling interpersonal variation in the outcome variable and its change within units. We are going to employ procedures to estimate both incidence and intensity of training under the inspection of group-specific trends. The combination of methodologies seeks to compensate for their separated usage but has the range of persistent limitations in the extrapolation of findings. The next chapter introduces the application of the described procedures into actual analysis and discussion of the upcoming findings.

Chapter 4. Analysis and Discussion

4.1. Introduction

This part delivers the main contribution of the current paper issuing the empirical results to the stated research question and discussing their implications. The analysis is structured chronologically with regard to the limited data availability for dependent variables. In the first chapter employer-sponsored training under the legal minimum wage introduction is approached. In the second chapter, training participation of the affected workers is analyzed within the 2014-2016 panel waves. The third chapter is dealing with training intensity. The last chapter includes the concluding discussion of all findings. We provide interim conclusions for each outcome separately. The key statistical results will be included throughout the text of the chapters. Supplementary statistics is provided in the Appendix.

4.2. Employer-Financed Training Incidence under the Minimum Wage Introduction in Germany

4.2.1. Dynamics and Predictors of Incidence

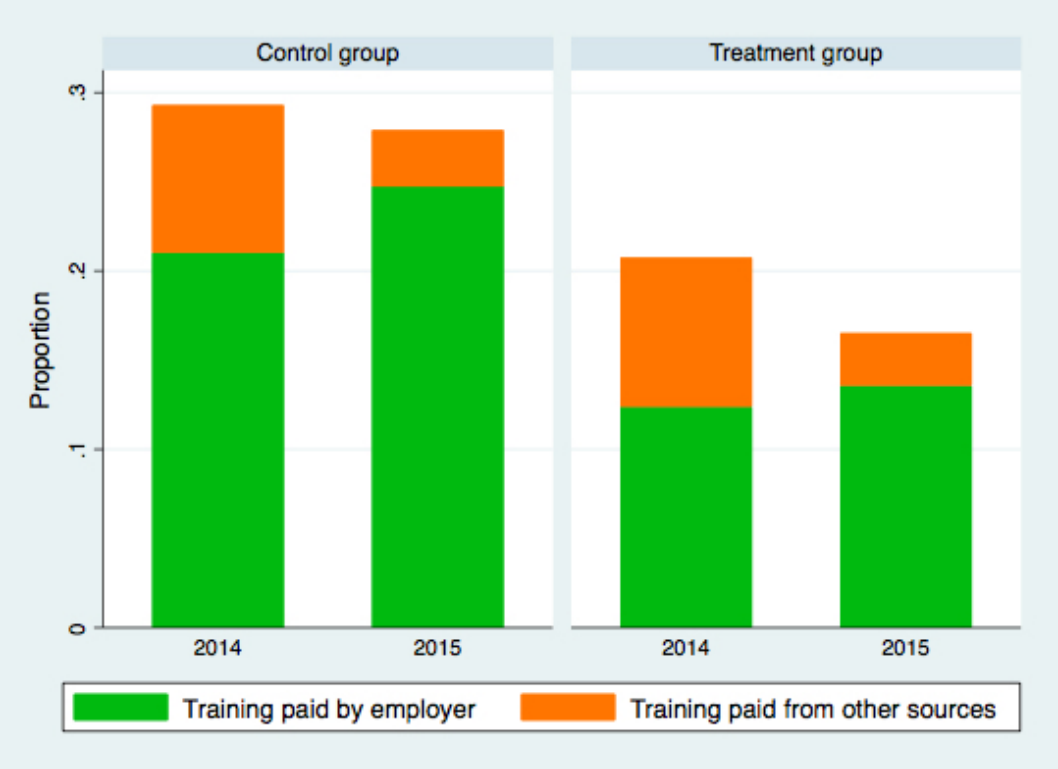
The discussion upon the impact of minimum wage on training opportunities on the workplace for is reasonable to start with employer-financed training. As it has been noted in the previous chapters, in Germany it represents the largest segment of further education activities and differentiates groups the most according to their participation. From the theoretical perspective, it is exponential to describe the potential effect of labor price increase. Employer-sponsored training portraits the intention of the firms for innovation, labor force and technical development, that in a short run often causes major expenditures. For employees, it takes an important share in the perceived quality of work and employer's attainment to the established labor relationships.

As the information upon training cost bearers is available only for 2014-2015 survey years, we have to limit the first step of analysis by this observation period. Nevertheless, as discussed in the previous chapters, it is impossible to provide a single treatment interpretation for the 2015 wave. On the one hand, as the information for the dependent variable refers to the previous year, it measures the training participation before the law officially comes into force,

namely pre-treatment period. On the other hand, the exact month of wage adjustments could not be estimated as well as one for the change in training policy if one takes place. We assume that the employers were previously aware of the law adoption, hence, the adjustment policies for the treatment group could have been overtaken already in 2014 either. Therefore, the 2015 survey year information could be also considered as the post-treatment effect of the minimum wage announcement [and not implementation]. We avoid a single definition at this point, as the comprehensive conclusion upon the short-term effects of the law will be made on the basis of a three-year perspective, adding the wave of 2016 as clearly post-treatment information.

Figure 1 opens the analysis in terms of descriptive population-averaged statistics. It graphically shows the observed proportions of people having participated in further professional education on different cost bearers [differentiating between employer and other sources (e.g. employee, employment agency, third-party)] as shares of all the affected by the law workers. Figure 1 delivers several starting points for the further analysis. First, it shows lower rates of training participation in the sample in comparison to the population-average of 37% (Bilger and Strauß 2015). [The figure is given for a holistic orientation and could not be used for analytic comparisons due to the differences in the sample construction and operationalization of the concepts]. In between-groups comparison, they are also clearly lower for the treatment one. Annual comparison of the training participation dynamics is omitted at this point and is comprehensively discussed in the next chapter within the three-period perspective. The focus of the discussion at this point is the sources for financing the training, available for 2014-2015 survey years. Figure 1 proves the dominance of employer-sponsored training activities and their further raise in 2015 in comparison to other sources of payment for both treatment and control group, although more profoundly in the latter. Other cost bearers could not be operationalized in more detail to keep the data comparable in the two years.

Figure 1. Financing Training Participation under the Minimum Wage Introduction in Germany: Descriptive Statistics



Source: SOEP Data 2014-2015, own calculations

Before the discussion shifts towards its main focus of employer-sponsored training, a broader notice is needed upon other sources of its financing. Table 47 of the Appendix delivers a deeper understanding of their dynamics of change. Remarkably is that in 2014, more than the third part of it (35.59%) has been paid in this way, being even higher (40.28%) in the treatment group. However, in 2015, its major shortage occurred to 15.08% of the overall overtaken activities [sample average] occurred. Nevertheless, the rate of training paid from other sources remains higher in the treatment group (17.81%) in comparison to the control one (11.32%). In order to prove the significance of the change in the overall percentage of employees having got training paid from other sources, we perform a McNemar's test that checks the difference of two proportions which are computed from dependent observations (Andreß, Golsch et al. 2013). The test statistics is significant at the 0.001 level ($p<0.001$). This proves the statistical significance of the described change in the dependent variable. The lack of information upon the actual distribution of costs among parties as well as extremely low absolute number of cases in the category allow only for speculative explanations for the presented statistics. The latter illustrates probably the inter-compensation between different sources of human capital

investments. Lower rates of firm human capital investments in the treatment group could become a motivation for its members to search for other cost bearers and/or invest on their own. These becomes less often, as the employer-sponsored training increases, which is illustrated by the 2015 survey year statistics. Subjective perceptions of the workplace security and employment requirements could be further examples of the explanations of the observed changes. Due to the complexity and multidimensionality of potential causal relationship, a qualitative research is the best methodological solution for the issue.

The provided statistics show that despite being a predominant resource of human capital investments, training provision from employer's side is not a widespread practice in the affected labor market segment. It is also proved by the dynamics of incidence of the event given in the Table 2 below. It shows the number of people who never received training within the study period, those who got it in both years and for whom the change [in any of the directions] took place. To enable the annual comparison, the calculations are performed using a balanced panel. Generally low rates of training costs coverage by the firms become clear by the fact that 80% (285/357) of the members of the treatment group and 65% (108/166) of respondents in the control group did not take part in employer-sponsored training in both years. Once again, the reasonability of the main methodology choice is being proved. The main part of the analysis will cover all the three table categories [unlike the fixed effect model, which would have been based only on the observations for whom the change in the dependent variable took place].

Table 2. Change in the Incidence of Employer-Financed Training between 2014 and 2015 Survey Years (Balanced Panel): Frequencies

Group	Total of observations	No training in both years	Training in both years	Change
Treatment	357	285	25	47
Control	166	108	24	34
Total	523	393	49	81

Source: SOEP Data 2014-2015, own calculations

Table 3 provides an extended view on the descriptive statistics upon the change in the incidence of employer-sponsored training between both survey years. Positive transitions are clearly dominating, with their higher incidence of 14% (23/166) in the control group than in the treatment group (8% (28/357)). This major difference is not observed in the number of negative transitions (incidences of the shortage in employer-financed training). They are relatively

equally distributed within both groups: 6,6% (11/166) and 5,3% (19/357) respectively. Therefore, we prove the positive change in employer-sponsored training in 2015 survey year on a descriptive basis.

Table 3. Employer-Financed Training Incidence between 2014 and 2015 Survey Years (Balanced Panel): Transition Frequencies

	Control group	Treatment group	Total
Positive transitions	23	28	51
Negative transitions	11	19	30

Source: SOEP Data 2014-2015, own calculations

In order to draw statistically significant conclusions upon the nature of the change and define its determinants, random effects model of logistic regression is presented in the Table 4 below. With regards to the central research question, the model makes clear that incidence of employer-sponsored training for the treatment group is significantly lower than one of the control group (Variable: *Affection by the minimum wage introduction).* Comparing workers being equal on all the other parameters, the odds of the dependent variable are reduced by the factor of 0.43 for those directly affected by the law. Nevertheless, for both groups, an increase in odds of training provision of 50% (100/2.00) in the annual perspective (Variable: *Survey year*) is indicated. *Business sector* dominates in predicting the training participation. Manufacturing is selected as a reference category to represent one of the largest and technologically developed branches with a generally high level of training participation (Bilger and Strauß 2015). Higher employer-financed training rates are observed for *Transportation and storage* branch, which is also potentially one of the most severely affected by the minimum wage due to the inclusion of Taxis. Affiliation to the public services and resulting positive externalities, knowledge intensive tasks, high share of project and group work, as well as low substitutability potential of professions could explain higher rates of employer-sponsored sector in *Education*, as well as *Human health and social work activities* branches. "Other sectors" category includes all the branches with the small number of affected workers [below 20 in the sample] and is assumed to represent the least influenced ones. As expected, most probably due to the already high wage level independently of the law, these sectors also enjoy an increased level of training provision. These conclusions are based on the positive regression coefficients and odds ratios of above 1. Broad confidence intervals and relatively high standard errors still

indicate major variation in sectoral training provision policies, potentially attributed to the heterogeneity of workers within branches. Likewise expressed in the hypotheses, higher training incidence is indicated at the *large companies* (B=1.48; OR=4.38).

On the individual level, job and performance-related characteristics influence human capital investments for the examined group. In the same manner as theoretically assumed, incidence of training provision is positively related to the *job complexity*. Namely, its each one point increases the odds of employer-financed training incidence by 55% (100/1,81). More profound affection of marginal employment by the minimum wage introduction is also observed in terms of the employer-sponsored training. Its lower rates are observed for the "mini-jobs" in comparison to the full-time ones (B=-2.09; OR=0.12); whereas, the significant effect is absent for the traditional part-time employment.

Referring to the performance-related characteristics, *education* is defined as a significant predictor of participation in employer-sponsored training. On the one hand, it is positively associated with the length of studies (61% (100/1.63) increase in the odds of dependent variable with each additional year of education), which goes in line with the principle of credibility in the human capital theory. The application of the latter with regard to the formal achieved degree, however, is further moderated by the characteristics of the German dual training system (Allmendinger 1989), signal and filter theory (Arrow 1973, Spence 1973, Seibert and Solga 2005). Two categories deliver significant results at this point. First, holders of post-secondary non-tertiary degrees risk lower rates of training provision (B=-2.51; OR=0.08). The possible assumption behind is the previously mentioned fact that profound share of their education takes place on the workplace so that they further need less continuing vocational training. Holders of the highest degrees (Masters or equivalent and higher) face even greater risk of its shortage (B=-4.06; OR=0.02). Several possible explanations can be delivered for that. With regard to their ability, these employees might be considered already highly qualified and, therefore, do not need additional training. Alternatively, estimated time for potential returns influences the investment decision. Employers (as well as employees themselves) might not view this employment relationship as long-term, seeing the worker as overqualified and, therefore, being likely to resign. *Personal characteristics* do not have a significant impact on the employer's human capital investments in the affected labor market segment, attributing all its heterogeneity to the job- and performance-related indicators.

Table 4. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction: Random Effects Model of Logistic Regression

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-10.73***(2.65)	0.00	0.00	0.00
Firm location. Baseline: East Germany, incl. Berlin	0.22 (0.47)	0.50	1.24	3.12
Business sector. Baseline: Manufacturing				
Wholesale and retail trade, repair of motor vehicles and motorcycles	0.62 (0.73)	0.44	1.86	7.86
Accommodation and food service activities	1.58 (0.95)	0.75	4.83	31.31
Transportation and storage	**2.34** (0.82)**	**2.10**	**10.37**	**51.24**
Administrative and support service activities	0.73 (0.91)	0.35	2.08	12.28
Education	**2.31* (0.95)**	**1.58**	**10.08**	**64.34**
Human health and social work activities	**2.49*** (0.73)**	**2.91**	**12.10**	**50.36**
Other sectors	**1.42* (0.63)**	**1.21**	**4.13**	**14.16**
Company size. Baseline: LT 20				
GE 20 LT 200	0.78 (0.61)	0.66	2.18	7.23
GE 200 LT 2000	1.14 (0.63)	0.92	3.13	10.67
GE 2000	**1.48* (0.66)**	**1.21**	**4.38**	**15.89**
Affection by the minimum wage introduction	**-0.84* (0.40)**	**0.20**	**0.43**	**0.95**
Labor income	0.00 (0.00)	1.00	1.00	1.00
Job tenure	0.03 (0.02)	0.98	1.03	1.08
Job complexity	**0.59** (0.23)**	**1.15**	**1.81**	**2.82**
Contract duration	0.97 (0.61)	0.80	2.65	8.78
Employment form. Baseline: Full-time employment				
Part-time employment	-0.60 (0.53)	0.20	0.55	1.54
Marginal employment	**-2.09* (0.92)**	**0.02**	**0.12**	**0.75**
Education: formal degree. Baseline: Lower secondary education and below				
Upper secondary education	-1.07 (0.75)	0.08	0.34	1.50
Post-secondary non-tertiary education	**-2.51* (1.24)**	**0.01**	**0.08**	**0.92**
Short-cycle tertiary education	-1.17 (1.31)	0.02	0.31	4.05
Bachelors or equivalent level	-2.23 (1.32)	0.01	0.11	1.43
Masters or equivalent level and above	**-4.06* (1.93)**	**0.00**	**0.02**	**0.76**
Education: duration of studies	**0.49** (0.20)**	**0.00**	**1.63**	**2.40**
Work experience	0.01 (0.04)	0.93	1.01	1.10
Age	-0.04 (0.04)	0.88	0.96	1.05
Gender. Baseline: Female	-0.62 (0.05)	0.20	0.54	1.43
Migration background. Baseline: No migration background				
Direct migration background	-0.39 (0.57)	0.22	0.67	2.08
Indirect migration background	-0.78 (0.64)	0.13	0.45	1.60
***Survey year. Baseline: 2014.* 2015**	**0.69** (0.26)**	**1.20**	**2.00**	**3.35**
N	884			
n	469			
Wald Chi2	56.10**			
Ll	-307.68			
lnsig2u	1.52			
sigma_u	2.14			
Rho	0.58			
LR test of rho=0. Chibar2(01)	36.59***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05
Source: SOEP Data 2014-2015, own calculations

A range of indicators has been presented to prove the statistical goodness of the model in the lower part of the table. Wald Chi2 is significant at 0.01 level, proving the fact that B-coefficients for predictors are significantly different from 0 (Wooldridge 2012). The significance of LR test of rho=0 proves the fact that modelling the current data using random effects is more preferable than ordinary logistic regression (Rabe-Hesketh and Skrondal 2008). In other words, although the selected method tests the general impact of predictors [instead of their change], there are major differences attributed to the panel variance. Their proportion is presented by the Rho indicator above. Giesselmann und Windzio (2013) define it also as a residual intra-class correlation in the share of variance contributed to the time-constant characteristics of units. To ensure the accuracy of approximation in the model (Rabe-Hesketh and Skrondal 2008), we run it several times with different number of integration points (up to 14) to prove the stabilization of results by the default option. The collinearity diagnostics (Tables 57-60 in the Appendix) proves the adequacy of the combination of predictors in the model (i.e. absence of multicollinearity). Following Wooldridge (2012) the observed strength of correlation remains acceptable.

We use the xtrho command (Rodrıguez and Elo 2003) in the extended application and interpretation (Rabe-Hesketh and Skrondal 2008) to gain an understanding of the marginal associations between the observed responses (Table 5 below). For an individual whose fixed part of the linear predictors is equal to the sample median, the marginal probability of getting an employer-sponsored training in one of the observation years is 0.11 and the joint probability of this event in both years is 0.05. The estimated odds ratio of 8.05 means that the odds of employer-financed training for an individual who had his training paid at the other occasion are 8 times higher than for an individual with the same characteristics who did not have his training paid. Squaring the Pearson correlation of 0.32, we show that training paid by an employer in one year explains about 10% of the variation in employer-paid training in the other. The results are consistent with the descriptive statistics on training incidence dynamics presented at the beginning of the analysis (Table 2).

Table 5. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction: Measures of Association at Median Fixed Part of the Model

Measure	Estimate	95% CI	
		Upper	Lower
Marginal probability	0.11	0.08	0.17
Joint probability	0.05	0.02	0.09
Odds ratio	8.05	4.66	14.05
Pearson's r	0.32	0.18	0.48
Yule's Q	0.78	0.65	0.87

Source: SOEP Data 2014-2015, own calculations

Table 6 below shows the average marginal effects that remain consistent with the findings in the already presented model and give an overview of the comparative strength of predictors. Strong positive effect on training provision is attributed to the firm-level characteristic – business sector. The highest indexes are observed by Human health and social work activities, Transportation and storage, Education branches. Strong negative average marginal effects are carried by two formal education degrees – Post secondary non-tertiary and Master and higher. Positive relationship between company size and training provision is also proven by the significant average marginal effect for middle-size companies (GE 200 LT 2000), which is absent in the logistic regression model. Together with the employment type, both indicators enjoy moderate impact on the dependent variable. The lowest value indexes are observed by job complexity, survey year and affection by the law variables. Before the final conclusion upon the predictors is formulated, their individual contributions are to be ranked.

Table 6. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction: Average Marginal Effects

	dy/dx (SE)	95% CI	
		Lower	Upper
Firm location. Baseline: East Germany, incl. Berlin	0.02 (0.03)	-0.05	0.08
Business sector. Baseline: Manufacturing			
Wholesale and retail trade, repair of motor vehicles and motorcycles	0.03 (0.04)	-0.05	0.11
Accommodation and food service activities	0.10 (0.07)	-0.03	0.24
Transportation and storage	**0.17** (0.06)**	**0.04**	**0.29**
Administrative and support service activities	0.04	-0.06	0.14
Education	**0.17* (0.08)**	**0.02**	**0.32**
Human health and social work activities	**0.18*** (0.05)**	**0.09**	**0.28**
Other sectors	**0.09* (0.04)**	**0.02**	**0.17**
Company size. Baseline: LT 20			
GE 20 LT 200	0.05 (0.04)	-0.02	0.12
GE 200 LT 2000	**0.07* (0.04)**	**0.00**	**0.15**
GE 2000	**0.10** (0.04)**	**0.02**	**0.18**
Affection by the minimum wage introduction	**-0.06* (0.03)**	**-0.11**	**-0.01**
Labor income	0.00 (0.00)	0.00	0.00
Job tenure	0.00 (0.00)	0.00	0.01
Job complexity	**0.04** (0.02)**	**0.01**	**0.08**
Contract duration	0.08 (0.04)	-0.02	0.16
Employment form. Baseline: Full-time employment			
Part-time employment	-0.05 (0.04)	-0.12	0.03
Marginal employment	**-0.13****	**-0.21**	**-0.04**
Education: formal degree. Baseline: Lower secondary education and below			
Upper secondary education	-0.09 (0.06)	-0.21	0.04
Post-secondary non-tertiary education	**-0.17* (0.08)**	**-0.34**	**-0.01**
Short-cycle tertiary education	-0.09 (-1.00)	-0.29	0.10
Bachelors or equivalent level	-0.17 (0.09)	-0.34	0.02
Masters or equivalent level and above	**-0.24** (0.09)**	**-0.41**	**-0.06**
Education: duration of studies	**0.04** (0.01)**	**0.00**	**0.06**
Work experience	0.00 (0.00)	0.00	0.00
Age	0.00 (0.00)	0.00	0.00
Gender. Baseline: Female	-0.05 (0.04)	-0.12	0.03
Migration background. Baseline: No migration background			
Direct migration background	-0.03 (0.04)	-0.11	0.05
Indirect migration background	-0.05 (0.04)	-0.12	0.03
***Survey year. Baseline: 2014.* 2015**	**0.05** (0.02)**	**0.01**	**0.09**

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculations

We employ the method of adequacy (Harrell 2001, Thompson 2009) due to its compatibility with the longitudinal data structure and Stata software. Logistic regression models have been run with each predictor individually and compared to the maximum likelihood of the one with all predictors included. The most explanatory power is attributed to the business sector, followed by job complexity and duration of education. Apart from the main body of explanations, this might be also attributed to the variation in the substitutability of different groups of professions. Under the absence of the target variable controlling for that, this assumption remains theoretical. Although labor income loses its significance when controlling for other characteristics, it remains a powerful predictor of employer-training provision. For the affection by the legal minimum wage introduction the opposite effect is observed: although it does not carry the most explanatory power when ranking the independent variables, it is significant in the complete model.

Table 7. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction: Ranking Predictors (Adequacy)

Single predictor included in the model	Ll	Wald Chi2
Model with all predictors included	*-307.68*	*56.10***
Business sector	**-376.48**	**27.00*** **
Job complexity	**-416.43**	**49.44*** **
Education: duration of studies	**-424.72**	**26.83*** **
Labor income	-432.89	39.38***
Education: formal degree	**-440.36**	**24.31*** **
Employment form	**-442.55**	**24.80*** **
Company size	**-450.29**	**19.13*** **
Job tenure	-450.61	21.13***
Work experience	-452.98	1.82
Affection by the minimum wage introduction	**-457.00**	**11.30*** **
Contract duration	-458.13	8.21**
Migration background	-458.65	4.53
Survey year	**-461.49**	**2.71**
Firm location	-462.62	0.63
Age	-462.63	0.55
Gender	-462.66	0.50

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Predictors that are significant in the complete model are marked with bold

Source: SOEP Data 2014-2015, own calculations

The discrepancies in the regressors' scores in comparison to the previous ranking (Table 6) are embedded in differences in their scaling and nature of both methods. Whereas adequacy principle seeks to model the contribution of the predictor to the complete variation of the outcome, average marginal effects estimate the impact of its one unit of change. The latter represents the whole range of values by dummy variables and less profound change by metric ones. Hence, we regard the adequacy method as prior to average marginal effects. An important conclusion, delivered by both models is the fact that wage increase after the law does explain a share of variation in the training provision, but not on its own. Factors outlined by the human capital theory do powerfully moderate the investments, also independently of the minimum wage. We attribute the most explanatory power to the firm-level, job-and performance-related indicators, whereas personal characteristics are neither significant nor powerful predictors of the employer-sponsored training participation in the segment affected by the minimum wage introduction.

At this point a first conclusion for the current findings could be formulated. The analysis above indicates the clear dominance of employer-provided training in the range of overtaken professional education activities within the observation period. We have indicated its increase within the target population in the survey years of 2014-2015. However, its rate is higher when anticipatory wage adjustments have been overtaken in comparison to the wage increase in a direct response to the law. The described model suggests that human capital investments in the observed labor market are mostly defined by the characteristics related to the workplace (firm-level indicators, job and performance-related individual indicators) and not personal ones. Firm-level characteristics influence training provision within the sector-specific characteristics and in partial consistence to the affection by the minimum wage introduction. An impact of job-related indicators is also stable with regard to the human capital theory and the law. Performance-related characteristic, namely formal degree of education challenges the application of the latter for the affected labor market segment in several defined points. The current analysis suggests that it is the matter of affection by the minimum wage introduction (time point of wage adjustment) that predicts the firm-paid training provision and not the actual sum of labor income. In order to deepen the understanding of the current findings, we test them in an annual and between-group perspectives.

4.2.2. Predictors: Within and Between-Group Comparison. Interaction Effects

The goal of this chapter is to define if there are differences in the effects of significant predictors within the control and treatment group. For this purpose, we employ interaction and average marginal effects, conditional-effects-plots (Kohler and Kreuter 2016). The latter are especially beneficial to illustrate non-linear multiplicative relationship and variation of predicted probability, holding other variables at fixed values (Andreß, Golsch et al. 2013).

Before the discussion is placed upon the predictors, we compare the patterns of change in training incidence between and within groups. Already in 2014, its chances are 6% lower for the members of the treatment group, slightly decreasing to 7% lower in 2015 (Table 8). These differences remain consistent despite the increase for both in 2015. The latter reproduces previously established inequalities, as the effect of the time predictor does not differ substantially between the control and treatment group. The chances for training incidence have increased by 6% and 5% respectively (Table 9).

Table 8. Employer-Financed Training Incidence and Affection by the Minimum Wage Introduction: Average Marginal Effects (Between-Group Comparison)

	2014	**2015**
Treatment group. Baseline: Control group	-0.06*	-0.07*

Note: *** p≤0.001, **p≤0.01, *p≤0.05
Source: SOEP Data 2014-2015, own calculations

Table 9. Employer-Financed Training Incidence and Affection by the Minimum Wage Introduction: Average Marginal Effects (Within-Group Comparison)

	Control group	**Treatment group**
2015. Baseline: 2014	0.06**	0.05**

Note: *** p≤0.001, **p≤0.01, *p≤0.05
Source: SOEP Data 2014-2015, own calculations

As defined through the above described analysis, the strongest predictor of employer-sponsored training incidence is the branch. Three interaction effects are significant in the model controlling for other independent variables (Table 10 below). In the Manufacturing branch

training incidence is higher for the members of the control group. The same is true for the Human health and social work activities, Education sectors indicated as the ones having the highest level of training incidence in the baseline model (Table 4). The current findings show that this is mainly attributed to its provision for the members of the control group. Inclusion of the interaction effect of the business sector and minimum wage affection, diminish the significance of the formal degree of education, which marginally contributes to the formation of the described branch-specific differences. Controlling for them points out higher training incidence in the middle-sized firms (GE 200 LT 2000). The impact of other dependent variables remains persistent.

Table 10: Determinants of Employer-Financed Training Incidence: Interaction Effects (Business Sector and Affection by the Minimum Wage Introduction)

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-9.22 (2.56) ***	0.00	0.00	0.02
Firm location. Baseline: East Germany, incl. Berlin	0.20 (0.46)	0.49	1.22	3.04
Business sector. Baseline: Manufacturing # Control Group				
Wholesale and retail trade, repair of motor vehicles and motorcycles # Control Group	0.49 (1.08)	0.19	1.63	13.62
Accommodation and food service activities # Control Group	-0.45 (1.80)	0.02	0.64	21.85
Transportation and storage # Control Group	1.40 (1.14)	0.44	4.06	37.88
Education # Control Group	**2.95* (1.51)**	**0.99**	**19.18**	**372.87**
Human health and social work activities # Control Group	**2.54** (0.95)**	**1.96**	**12.67**	**82.02**
Other sectors # Control Group	-0.17 (0.87)	0.15	0.85	4.65
Manufacturing # Treatment Group	**-2.00* (0.95)**	**0.02**	**0.14**	**0.87**
Wholesale and retail trade, repair of motor vehicles and motorcycles # Treatment Group	-0.94 (0.92)	0.06	0.39	2.37
Accommodation and food service activities # Treatment Group	0.69 (1.11)	0.23	1.99	17.51
Transportation and storage # Treatment Group	1.15 (1.01)	0.44	3.16	22.97
Administrative and support service activities # Treatment Group	-0.14 (1.01)	0.12	0.87	6.32
Education # Treatment Group	0.41 (1.10)	0.17	1.50	13.05
Human health and social work activities # Treatment Group	0.52 (0.91)	0.29	1.69	9.98
Other sectors # Treatment Group	0.73 (0.81)	0.43	2.08	10.17
Company size. Baseline: LT 20. GE 20 LT 200	0.82 (0.61)	0.68	2.27	7.54
GE 200 LT 2000	**1.26* (0.63)**	**1.02**	**3.53**	**12.23**
GE 2000	**1.47* (0.67)**	**1.17**	**4.33**	**16.04**
Labor income	0.00 (0.00)	1.00	1.00	1.00
Job tenure	0.03 (0.02)	0.98	1.03	1.08
Job complexity	**0.58** (0.23)**	**1.15**	**1.78**	**2.77**
Contract duration	0.91 (0.61)	0.76	2.49	8.16
Employment form. Baseline: Full-time employment Part-time employment	-0.61 (0.52)	0.20	0.54	1.51
Marginal employment	**-2.00* (0.91)**	**0.02**	**0.13**	**0.80**
Education: formal degree. Baseline: Lower secondary education and below				
Upper secondary education	-0.81 (0.74)	0.11	0.45	1.89
Post-secondary non-tertiary education	-2.04 (1.22)	**0.01**	**0.13**	**1.41**
Short-cycle tertiary education	-0.37 (1.36)	0.05	0.69	9.94
Bachelors or equivalent level	-1.46 (1.30)	0.02	0.23	2.97
Masters or equivalent level and above	-3.39 (1.90)	0.00	0.03	1.37
Education: duration of studies	**0.39 * (0.19)**	**1.01**	**1.48**	**2.15**
Work experience	0.01 (0.04)	0.93	1.01	1.10
Age	-0.04 (0.04)	0.88	0.96	1.04
Gender. Baseline: Female	-0.62 (.0.50)	0.20	0.54	1.43
Migration background. Baseline: No migration background Direct migration background	-0.42 (0.60)	0.22	0.66	2.02
Indirect migration background	-0.83 (0.64)	0.13	0.44	1.51
***Survey year. Baseline:2014.* 2015**	**0.70** (0.26)**	**1.20**	**2.01**	**3.37**
N	874			
n	463			
Wald Chi2	58.43**			
Ll	-299.72			
lnsig2u	1.42			
sigma_u	2.03			
Rho	0.56			
LR test of rho=0. Chibar2(01)	30.97***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05; empty category

Source: SOEP Data 2014-2015, own calculations

We estimate the average marginal effects to compare group discrepancies under the sector affiliation and their persistence after the general increase in training provision. Table 10 identifies two sectors with significant between-group differences. In the Manufacturing branch, the chances for employer-sponsored job-related training are 8% lower for the treatment group in comparison to the control group; decreasing further to 12% lower for the survey year 2015. Significant differences are also observed in the Human health and social work activities branch. Although, its rates of training provision are higher in comparison to Manufacturing, the discrepancies upon the wage adjustment are more profound. Namely, the workers in the treatment group have 20% lower chances of getting their training paid by the employer in comparison to the control group with the further slight decrease to 22% in 2015. Higher training incidence in the branch in comparison to the others is potentially associated with the institutionalized sectoral standards. The latter stand in a direct connection with wage tariff regulations that differ for the treatment and control group and, therefore, cause discrepancies in training provision.

Table 11. Employer-Financed Training Incidence and Business Sector under the Minimum Wage Introduction: Average Marginal Effects (Between-Group Comparison)

	2014	**2015**
	Treatment group. Baseline: Control group	
Manufacturing	-0.08*	-0.12*
Wholesale and retail, repair	-0.09	-0.11
Accommodation and food service	0.08	0.10
Transportation and storage	-0.02	-0.03
Education	-0.26	-0.29
Human health and social work	-0.20*	-0.22**
Other sectors	0.06	0.08

Note: *** p≤0.001, **p≤0.01, *p≤0.05; empty category

Source: SOEP Data 2014-2015, own calculations

Table 12 shows the significant increase in training provision for both groups across all the sectors. The highest rates are observed for the control group in Transportation and storage and Human health and social work activities sectors (8% higher chances in comparison to the previous year). In the latter, 7% increase is also observed for the members of the treatment group, who enjoy a moderate increase across other sectors either.

Table 12. Employer-Financed Training Incidence and Business Sector under the Minimum Wage Introduction: Average Marginal Effects (Within-Group Comparison)

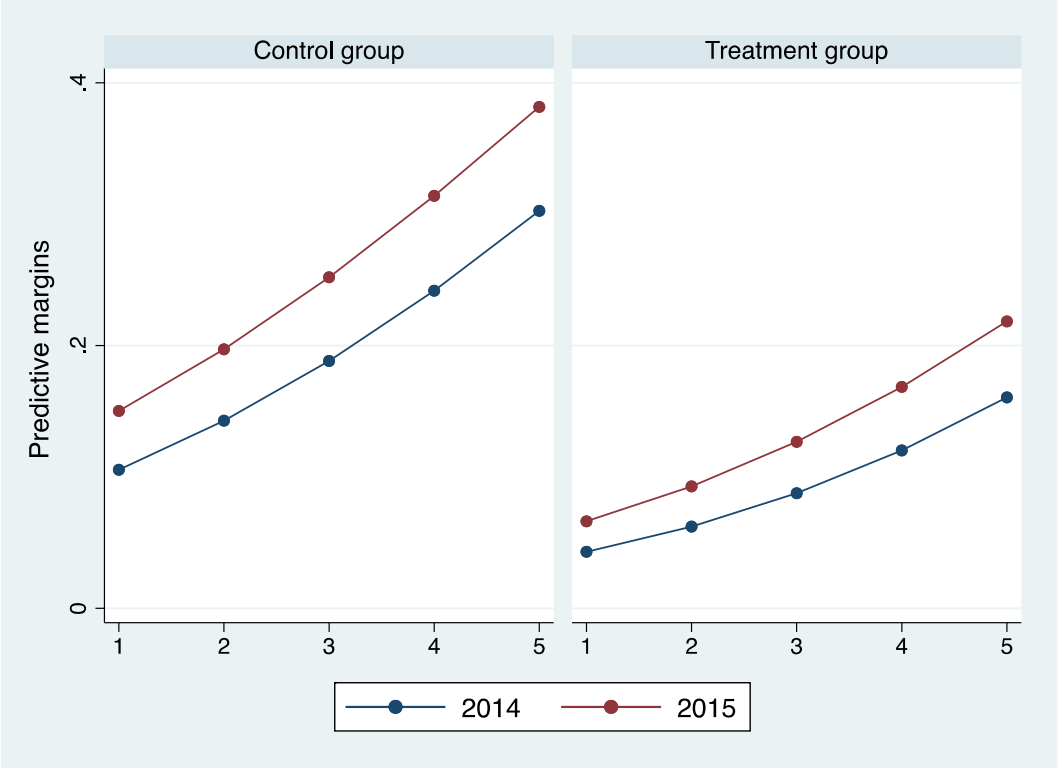
	Control group	Treatment group
	2015. Baseline: 2014	
Manufacturing	0.04*	0.03*
Wholesale and retail, repair	0.05**	0.04*
Accommodation and food service	0.06*	0.05*
Transportation and storage	0.08**	0.06**
Administrative and support service activities	0.05*	0.04*
Education	0.08**	0.06*
Human health and social work activities	0.08**	0.07**
Other sectors	0.06**	0.05**

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculations

The predictor with the second highest share in explaining the variation of training incidence for the workers affected by the minimum wage introduction is the job complexity. Conditional-effects-plot (Figure 2) proves the consistence of the findings with the ground assumptions of the human capital theory, as well as equivalent increase for the survey year 2015. The latter still does not influence the prevalent differences between treatment and control group. For instance, the employees who perform most complex jobs and experience wage adjustment between 2014 and 2015, have only slightly exceed the level of training provision for the employees having been doing middle-skilled jobs and having their wage adjusted in 2014.

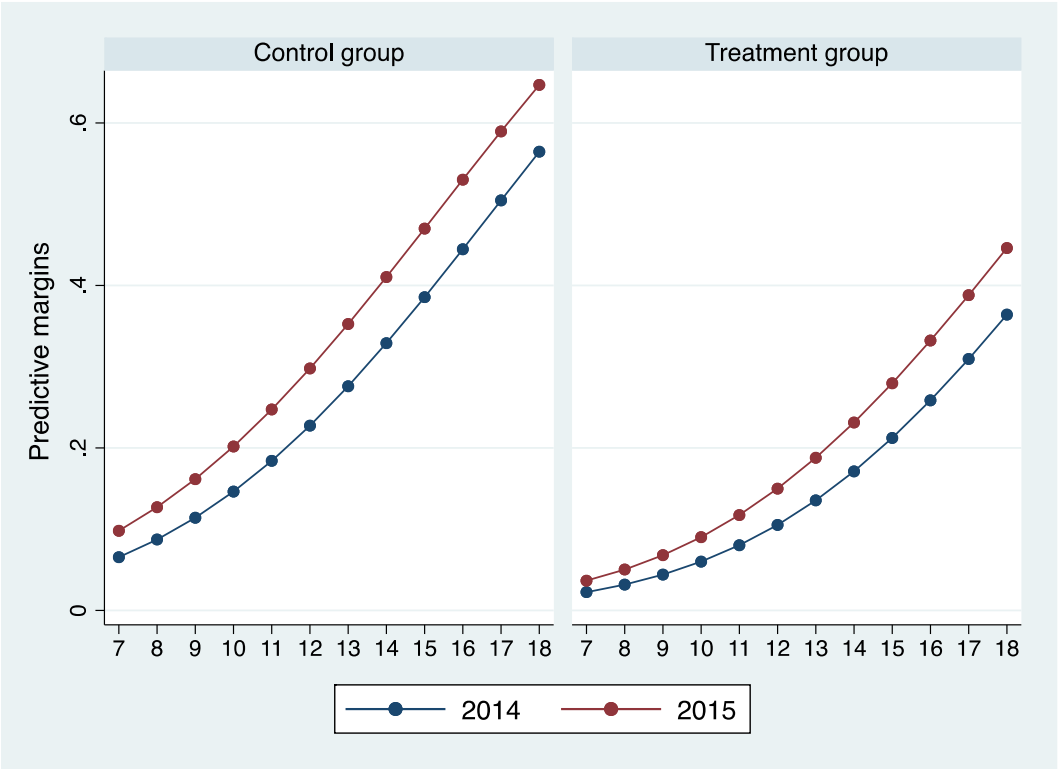
Figure 2. Employer-Financed Training Incidence and Job Complexity under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2015, own calculations

Similar effect is observed by the education duration (Figure 3). It is positively associated with the training incidence for both groups as predicted by the human capital theory. Nevertheless, within the control group the slope of the conditional effect line is steeper indicating more rapid increase in the training provision with additional years of education. In terms of the human capital theory, it means that higher ability of these workers has more profound impact on their credit constrains in comparison to those in the treatment group.

Figure 3. Employer-Financed Training Incidence and Education Duration under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2015, own calculations

Table 13 shows the interaction effects in terms of the formal degree of education and treatment assignment. The understanding of their effect is further developed and visualized by the conditional-effects-plot (Figure 4). As already indicated in the basic model, its effect does not go in line with the human capital theory. For the low and middle skilled workers (up to Post-secondary non-tertiary education), training provision actually decreases for the holders of higher degrees in both groups. When considering the mentioned direct relationship between job complexity and qualification, it is reasonable to assume that these workers do simple less demanding tasks. Holding a qualification reduces the need to train workers for performing them. An increase in the conditional effect line is observed by the skilled workers who most probably bring the most return from the human capital investment within the observed labor market segment. The interaction effect at this point is, however, not significant. As already discussed in the basic model, highly skilled workers are considered overqualified and have, therefore, lowest chances of human capital investments. A slight increase in training provision as well as similar pattern of change are persistent for both treatment and control group.

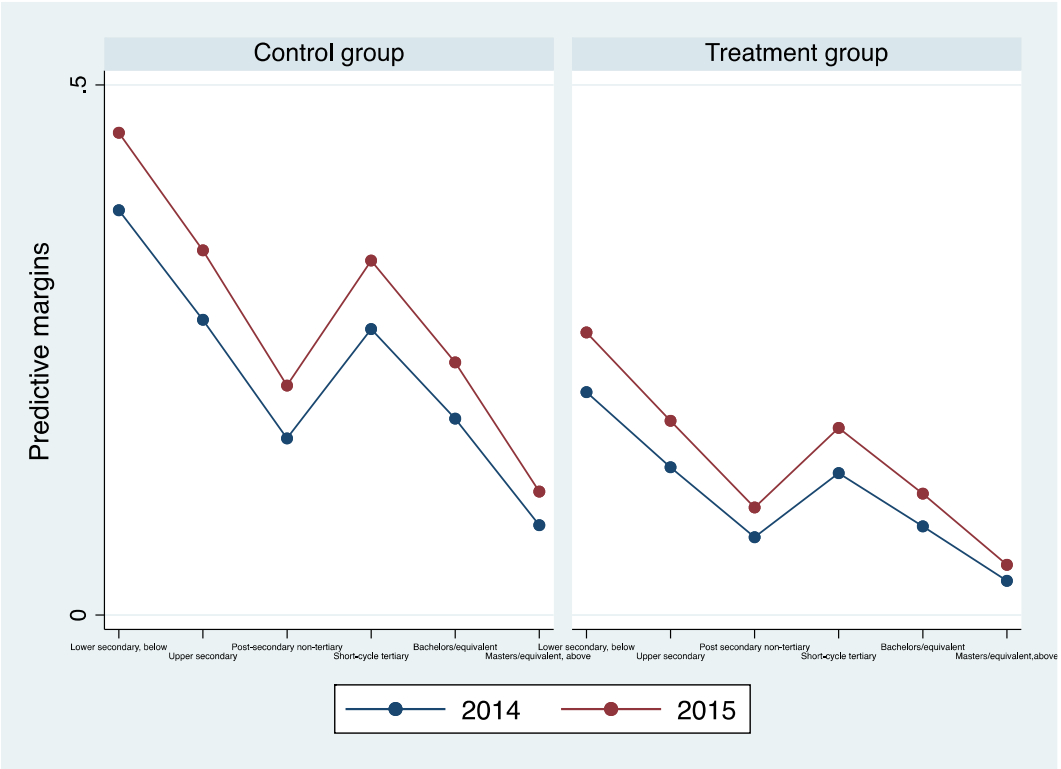
Table 13. Determinants of Employer-Financed Training Incidence: Interaction Effects (Formal Degree of Education and Affection by the Minimum Wage Introduction)

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-9.85*** (2.71)	0.00	0.00	0.01
Firm location. Baseline: East Germany, incl. Berlin	0.27 (0.47)	0.52	1.31	3.30
Business sector. Baseline: Manufacturing				
Wholesale and retail trade, repair of motor vehicles and motorcycles	0.68 (0.75)	0.46	1.97	8.50
Accommodation and food service activities	1.69 (0.96)	0.82	5.40	35.59
Transportation and storage	**2.52** (0.83)**	**2.45**	**12.41**	**62.83**
Administrative and support service activities	0.77 (0.92)	0.35	2.15	14.00
Education	**2.48** (0.95)**	**1.84**	**11.92**	**77.19**
Human health and social work activities	**2.61*** (0.74)**	**3.18**	**13.54**	**57.68**
Other sectors	**1.49* (0.64)**	**1.27**	**4.43**	**15.45**
Company size. Baseline: LT 20. GE 20 LT 200	0.72 (0.61)	0.62	2.05	6.80
GE 200 LT 2000	1.14 (0.63)	0.91	3.11	10.63
GE 2000	**1.48* (0.66)**	**1.21**	**4.40**	**15.94**
Labor income	0.00 (0.00)	1.00	1.00	1.00
Job tenure	0.03 (0.02)	0.98	1.03	1.08
Job complexity	**0.56* (0.23)**	**1.12**	**1.75**	**2.74**
Contract duration	0.93 (0.61)	0.76	2.52	8.34
Employment form. Baseline: Full-time employment Part-time employment	-0.66 (0.53)	0.18	0.51	1.45
Marginal employment	**-2.16* (0.93)**	**0.02**	**0.12**	**0.71**
Education: formal degree. Baseline: Lower secondary education and below # Control group				
Upper secondary education # Control group	**-2.09* (1.02)**	**0.02**	**0.12**	**0.91**
Post-secondary non-tertiary education # Control group	-2.31 (1.49)	0.00	0.10	1.83
Short-cycle tertiary education # Control group	-0.97 (1.90)	0.00	0.38	15.90
Bachelors or equivalent level # Control group	-2.86 (1.49)	0.00	0.06	1.06
Masters or equivalent level and above # Control group	**-4.64* (2.29)**	**0.00**	**0.01**	**0.86**
Lower secondary education and below # Treatment group	-1.98 (1.20)	0.01	0.14	1.45
Upper secondary education # Treatment group	**-2.31* (1.00)**	**0.01**	**0.10**	**0.70**
Post-secondary non-tertiary education # Treatment group	**-4.52** (1.54)**	**0.00**	**0.01**	**0.22**
Short-cycle tertiary education # Treatment group	-3.10 (1.71)	0.00	0.05	1.29
Bachelors or equivalent level # Treatment group	**-3.70* (1.56)**	**0.00**	**0.02**	**0.53**
Masters or equivalent level and above # Treatment group	**-5.65** (2.16)**	**0.00**	**0.01**	**0.24**
Education: duration of studies	**0.49** (0.20)**	**1.11**	**1.64**	**2.41**
Work experience	0.02 (0.04)	**0.93**	**1.02**	**1.11**
Age	-0.05 (0.05)	0.87	0.95	1.04
Gender. Baseline: Female	-0.69 (0.51)	0.18	0.50	1.36
Migration background. Baseline: No migration background Direct migration background	-0.49 (0.58)	0.20	0.62	1.93
Indirect migration background	-0.83 (0.65)	0.12	0.44	1.56
***Survey year. Baseline: 2014.* 2015**	**0.69** (0.26)**	**1.19**	**2.00**	**3.34**
N	884			
n	469			
Wald Chi2	56.65**			
Ll	-305.73			
lnsig2u	1.51			
sigma_u	2.13			
Rho	0.58			
LR test of rho=0. Chibar2(01)	34.94***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculation

Figure 4. Employer-Financed Training Incidence and Formal Degree of Education under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2015, own calculations

Further job-related characteristic, significantly affecting training incidence in terms of the presented model is the type of employment. The lowest chances are attributed to the members of the treatment group who are marginally employed, followed by those in the part-time employment (Table 14 below). The differences are not significant for the employment segments of the control group, nor they are supported by significant average marginal effects (Table 61 in the Appendix). An increase of training provision is indicated for the full- and part-time employed in both groups, again with the higher pace in the control one (Table 15).

Table 14. Determinants of Employer-Financed Training Incidence: Interaction Effects (Type of Employment and Affection by the Minimum Wage Introduction)

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-10.71 (2.66)	0.00	0.00	0.00
Firm location. Baseline: East Germany, incl. Berlin	0.22 (0.47)	0.50	1.25	3.15
Business sector. Baseline: Manufacturing				
Wholesale and retail trade, repair of motor vehicles and motorcycles	0.61 (0.74)	0.43	1.83	7.81
Accommodation and food service activities	1.57 (0.96)	0.74	4.82	31.45
Transportation and storage	**2.36** (0.82)**	**2.11**	**10.54**	**52.67**
Administrative and support service activities	0.74 (0.91)	0.35	2.10	12.49
Education	**2.31* (0.95)**	**1.57**	**10.11**	**65.14**
Human health and social work activities	**2.50*** (0.74)**	**2.88**	**12.16**	**52.43**
Other sectors	**1.42* (0.63)**	**1.20**	**4.15**	**14.30**
Company size. Baseline: LT 20. GE 20 LT 200	0.79 (0.62)	0.66	2.20	7.39
GE 200 LT 2000	1.15 (0.63)	0.92	3.17	10.91
GE 2000	**1.49* (0.66)**	**1.21**	**4.44**	**16.31**
Labor income	0.00 (0.00)	1.00	1.00	1.00
Job tenure	0.03 (0.02)	0.98	1.03	1.08
Job complexity	**0.59** (0.23)**	**1.15**	**1.80**	**2.81**
Contract duration	0.96 (0.62)	0.78	2.61	8.72
Employment form. Baseline: Full-time employment # Control group				
Part-time employment # Control group	-0.48 (0.76)	0.14	0.62	2.72
Marginal employment # Control group	-1.62 (1.57)	0.01	0.20	4.26
Full-time employment # Treatment group	-0.76 (0.48)	0.18	0.47	1.21
Part-time employment # Treatment group	**-1.42* (0.66)**	**0.07**	**0.24**	**0.88**
Marginal employment # Treatment group	**-3.03** (1.12)**	**0.00**	**0.05**	**0.44**
Education: formal degree. Baseline: Lower secondary education and below				
Upper secondary education	-1.06 (0.76)	0.08	0.35	1.52
Post-secondary non-tertiary education	**-2.49* (1.24)**	**0.00**	**0.08**	**0.95**
Short-cycle tertiary education	-1.18 (1.32)	0.02	0.31	4.05
Bachelors or equivalent level	-2.20 (1.33)	0.00	0.11	1.50
Masters or equivalent level and above	**-4.04* (1.94)**	**0.00**	**0.02**	**0.79**
Education: duration of studies	**0.49** (0.20)**	**1.10**	**1.63**	**2.40**
Work experience	0.01 (0.04)	**0.93**	**1.01**	**1.10**
Age	-0.05 (0.05)	0.96	0.87	1.05
Gender. Baseline: Female	-0.63 (0.50)	0.20	0.53	1.43
Migration background. Baseline: No migration background Direct migration background	-0.39 (0.58)	0.22	0.68	2.10
Indirect migration background	-0.80 (0.65)	0.13	0.45	1.59
***Survey year. Baseline: 2014.* 2015**	**0.70*** (0.26)**	**1.20**	**2.01**	**3.37**
N	884			
n	469			
Wald Chi2	55.45**			
Ll	-307.60			
lnsig2u	1.54			
sigma_u	2.16			
Rho	0.59			
LR test of rho=0. Chibar2(01)	36.28***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculations

Table 15. Employer-Financed Training Incidence and Type of Employment: Average Marginal Effects (Within-Group Comparison)

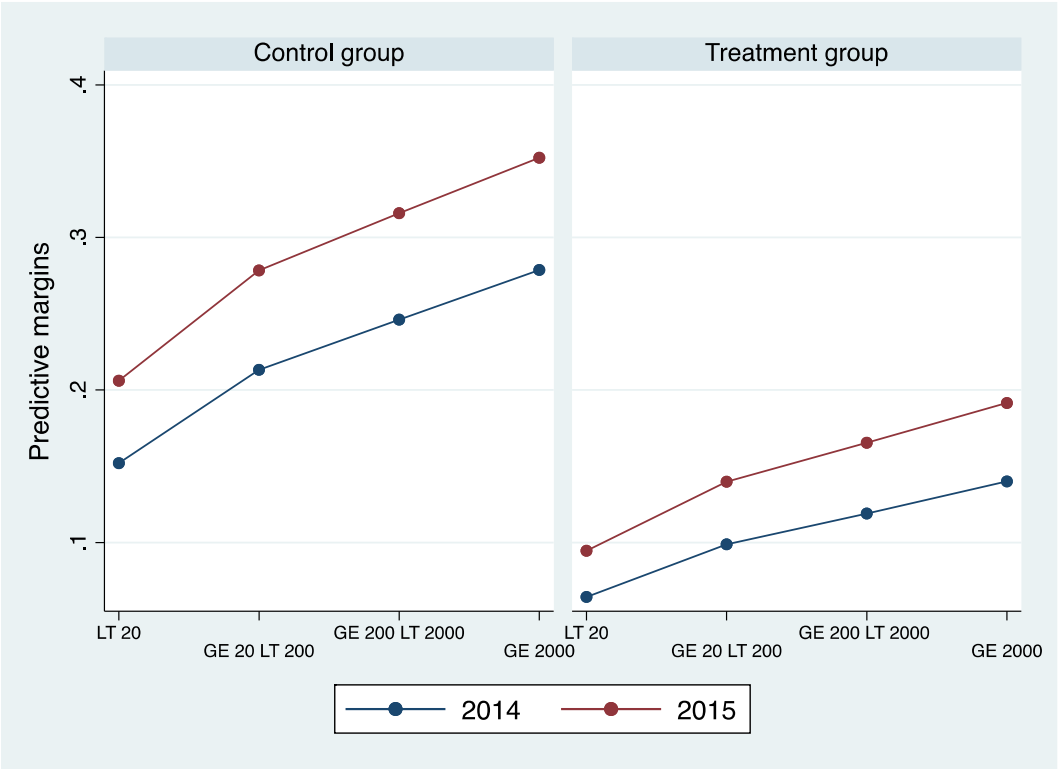
	Control group	Treatment group
	2015. Baseline: 2014	
Full-time employment	0.07**	0.05**
Part-time employment	0.06**	0.04**
Marginal employment	0.04	0.02

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculations

Figure 5 portraits the conditional effect of the company size on the dependent variable. Similar to the impact of other predictors, the pattern of change does not differ between groups and these differences remain persistent in 2015 survey year. For example, the probability of getting training for the members of the treatment group still remains lower than the one of the control group in small companies. At the same time, the chances for workers in the treatment group to get training at small companies are extremely low (close to 0), which is slightly improved after the predominant increase in 2015. We also reject the assumption upon the disproportionally negative effect of the minimum wage introduction on training opportunities in small companies, for which an increase also took place, though on a short-term basis.

Figure 5. Employer-Financed Training Incidence and Company Size under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2015, own calculations

Table 16 summarizes interpretations of findings in the current chapter. In general terms, lower incidence of training provision for the treatment group is observed by every significant predictor (although is absent in few categories), as well as its increase in both groups for 2015 wave. On the sectoral level, which represents the most variation in training provision, Human health and social work activities branch shows the highest level of employer-sponsored training, as well as the largest gap when comparing two sub-samples. Similar picture with the lower magnitude of differences is observed in the Education sphere. Training provision in the Transportation and storage branch as well as in the sectors less affected by the labor price increase is rather homogenous: group differences are not significant for these categories. The effects of job complexity and duration of education are identical: for both direct relationship is observed with persistent group differences and annual increase across all categories. No linear connection is present by the formal degree of education: skilled and highly skilled workers in both groups are placed under the risk of lower human capital investments, which is preserved despite the indicated increase in the dependent variable. Concerning the employment type,

training provision is homogenous by full-time workers unlike the part-time ones. Whereas both categories enjoy the indicated raise of human capital investments, whereas marginal employment remains the one with its lowest level. The effect of the size of the company is similar to the one of job complexity, although no statistically significant effect is observed for the middle-size companies. Indicated patterns are produced by various degrees of affection by the law for different labor market segments as well as independent influence of workplace-related factors discussed in the theoretical overview.

Table 16. Overall, Within- and Between-Groups Effects of Significant Predictors of Employer-Financed Training Incidence under the Minimum Wage Introduction

Predictor	Value	Impact: Baseline model	Between-group differences	Within-group increase in 2015	
				Control group	Treatment group
Business sector	*Manufacturing*	Baseline category	Yes	Yes	Yes
	Human health, social work	Highest training incidence in sectoral comparison	Yes	Yes	Yes
	Transportation and storage	Second highest training incidence in sectoral comparison	No	Yes	Yes
	Education	Third highest training incidence in sectoral comparison	Yes	Yes	Yes
	Other sectors	Forth highest training incidence in sectoral comparison	No	Yes	Yes
Job complexity	*1-5*	Positive impact on dependent variable	Yes	Yes	Yes
Duration of education	*7-18*	Positive impact on dependent variable	Yes	Yes	Yes
Formal degree of education	*Lower secondary, below*	Baseline category	Yes	Yes	Yes
	Post-secondary non-tertiary	Second lowest chances of training provision in cross-category comparison			
	Masters/equivalent, above	Lowest chances of training provision in cross-degree comparison			
Type of employment	*Full-time*	Baseline category	No	Yes	Yes
	Part-time	No significant effect	Yes	Yes	Yes
	Marginal	Lowest chances of training provision in cross-type comparison	Yes	No	No
Company size	*LT 20*	Baseline category	Yes	Yes	Yes
	GE 200 LT 2000	Significant positive average marginal effect			
	GE 2000	Highest rate of training provision in cross-category comparison			

Source: Chapters 4.2.1-4.2.2 of the paper

4.2.3. Minimum Wage Introduction and Employer-Financed Training Incidence: Interim Conclusion

The first part of the analysis has shown that minimum wage introduction reproduces and deepens existing inequalities in training provision, as predicted in the theoretical overview. Although an annual raise in its incidence is observed, its pace preserves existing inequalities. Those are mainly attributed to the job characteristics on the firm and individual level. Sectoral minimum wage affection partially explains variation in training provision. For instance, in the severely affected Transportation branch, its incidence is higher than in the "Other sectors" category which is supposed to represent the ones with the least affection by the law. Other highly affected service sectors do not show any significant variation in these terms. As predicted, large companies train their workers the most. No territorial variation has been detected at this point.

On the individual level, consistence with the human capital theory is limited. On the one hand, our findings prove it in terms of the job complexity, duration of education and employment type. On the other hand, its application remains challenged by the non-linear relationships of the formal degree of education to the employer-sponsored continuous vocational education. No effect of the personal characteristics on the dependent variable has been defined. The current analysis has also indicated statistically significant decrease in training solely paid from other sources than employer.

We find no major differences in the effect of predictors based on the treatment assignment, but discrepancies in training provision at single observation points. We do admit that anticipatory wage adjustments could be both considered causes and outcomes of the characteristics varying between both groups. We also take into consideration the prevalence of human capital theory patterns over minimum wage introduction in predicting the dependent variable. Nevertheless, we do find several contradictions attributing them to the peculiarities of the studied labor market. These conclusions remain segmented without the synthesis with the participation in training activities of any kind, as well as with the latency of the changes in a longer perspective. This task is performed in the next chapter.

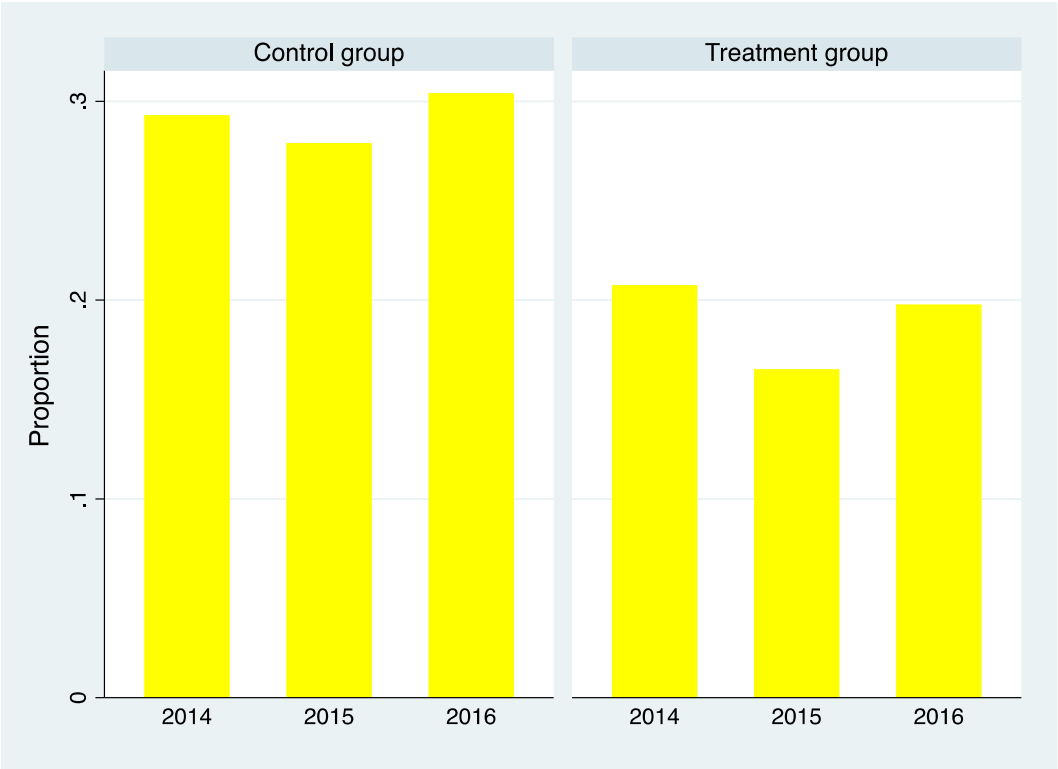
4.3. Training Incidence under the Minimum Wage Introduction in Germany

4.3.1. Dynamics and Predictors of Incidence

The majority of the theoretical arguments of the change in training participation under the minimum wage introduction refer to employer-sponsored training, which also constitutes the largest segment of adult education activities in Germany. Nevertheless, the lack of detailed information upon the costs, shares of cost bearers in financing training, as well as its organization, often makes strict conceptual differentiations problematic. Therefore, training incidence is widespread associated with the participation rate in any kind of further education activities. Whereas employees' human capital investments reflect individual attitudes towards lifelong learning and employer's ones are the expression of developmental managerial strategies, training incidence at any costs is a suitable measure for comparing chance equality of different groups and its development. In a limited longitudinal perspective of the current research, we observe the link between professional and educational inequalities as well as their persistence under the major labor market reform. In the analysis below, we follow already established procedure applied for employer-provided training to ensure the comparability of results and incorporate the advantages of broadening the time perspective to three years.

Figure 6 below shows the development of participation rate in the two groups within the observation period. As it has been already discussed in the previous chapter, for both, its slight fall in 2015 survey year has been detected, presumably due to the shortage in the activities solely paid from other sources than an employer, as noted in the previous chapter. Low number of cases in the category and lack of detailed information upon cost shares allow only for speculative assumptions with this regard. The restoration of the training incidence to the level of 2014 (with further slight increase in the control group and slight decrease in the treatment group) has taken place according to the 2016 survey year results. Group discrepancies in training participation remain persistent over the whole observation period. The descriptive statistics indicates a negative impact of the minimum wage introduction on the training incidence shortly before the law, which is, neglected after the law has come into force. Wage adjustment period does not seem to have an impact on the direction of training incidence development but on its absolute value at a given time point.

Figure 6. Training Incidence under the Minimum Wage Introduction in Germany: Descriptive Statistics



Source: SOEP Data 2014-2016, own calculations

Training incidence dynamics on the individual level shares similar patterns with the employer-sponsored one and is shown in the Table 17 below. As the findings are drawn from two different samples, they are only contingently comparable. The share of respondents who never took part in training activities between 2014 and 2016 survey waves remains relatively high. These are 64% of the treatment group (194/302) and 46% (63/136) of the control group, which shows the positive tendency in comparison to the corresponding indicators of employer-financed training (80% and 65% respectively). This lays in broadening the observation period as well as the scope of training activities. Expansion of training itself is less probable: participation rates have not increased, and the observed numbers are a product of interaction between positive and negative transitions (Table 18). Within- and between-group changes in their rates are predominantly stable. Extremely low shares of respondents (7% of the treatment group and 16% of the control group) regularly took part in continuing vocational education within the observation period. Not only participation rates but their consistency enables training to fulfill its functions. On this basis, we agree on the generally weakly established lifelong learning system in the observed labor market segment, discussed in the theoretical background.

Table 17. Change in Training Incidence between 2014 and 2016 Survey Years (Balanced Panel): Frequencies

	Total of observations	No training at three occasions	Training at three occasions
Treatment group	302	194	20
Control group	136	63	22
Total	438	257	42

Source: SOEP Data 2014-2016, own calculations

Table 18. Training Incidence between 2014 and 2016 Survey Years (Balanced Panel): Transition Frequencies

	Control group	Treatment group	Total
2014-2015 survey years			
Positive transitions	22	24	46
Negative transitions	17	33	50
2015-2016 survey years			
Positive transitions	13	35	48
Negative transitions	16	29	45
2014-2016 survey years			
Positive transitions	16	27	43
Negative transitions	14	30	44

Source: SOEP Data 2014-2016, own calculations

The descriptive findings are reflected in longitudinal modelling of determinants of training incidence using random coefficients (Table 19 below). There is no statistically significant change in training participation rate in an annual comparison. Looking back at the findings of the previous chapter an important conclusion can be drawn at this point. An increase in employer-financed training incidence in the target population before the law introduction is attributed solely to the employers' human capital investments and did not cause a significant increase in the continuing vocational education participation. It appears logical to improve the productivity of workers before the increase in the labor force price, as afterwards additional expenditures become furthermore problematic. The assumption is reasonable due to the major debates widely taking place before the actual minimum wage implementation. Nevertheless, these investments are characterized by the major selectivity upon the workers' education, job complexity and employment type. Reproduction of existing inequalities by the minimum wage introduction is further reflected in the higher rates of training provision in the control group,

despite anticipatory wage adjustments taking place in this period. There is no opportunity to conclude upon the development of firm human capital investments after the law introduction due to the absence of the information in the dataset. Therefore, we proceed further with the prior determinants of training incidence on the minimum wage labor market.

Some of the already observed determinants of employer-sponsored training are present in the model. In particular, *sectoral variation* remains one of the most powerful predictors of training participation rate and affiliation to the *Transportation and storage* as well as *Human health and social work activities* sectors positively influences it [Manufacturing remains a reference category]. Taking a retrospective view on the findings in the previous chapter, higher rates of employer-sponsored training in these sectors are potentially derived from a basically higher levels of training participation there. It might in return stimulate firm human capital investments. The same counts for the *company size, job complexity* and *type of employment*, thus, on the descriptive and not causal basis. Low training incidence is also observed by the part-time and marginal employment, as well as employees in simple jobs. The respective explanations of the previous step apply here as well.

The only characteristic differentiating training incidence and employer-sponsored one is the *gender*, namely lower rates of training participation for men. As the finding contradicts the basics of the human capital theory, we attribute the observed pattern to the characteristics of the minimum wage labor market and formulate explanatory conclusions after examining group-specific trends. As gender differences are not observed by employer-sponsored training, they are a product of employee's and/or third-party training initiatives.

Table 19. Determinants of Training Incidence under the Minimum Wage Introduction: Random Effects Model of Logistic Regression

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-7.20*** (2.00)	0.00	0.00	0.04
Firm location . Baseline: East Germany, incl. Berlin	0.53 (0.37)	0.82	1.71	3.55
Business sector. Baseline: Manufacturing				
Wholesale and retail trade, repair of motor vehicles and motorcycles	-0.03 (0.53)	0.34	0.97	2.73
Accommodation and food service activities	0.69 (0.70)	0.51	2.00	7.88
Transportation and storage	**1.69** (0.61)**	**1.64**	**5.43**	**18.00**
Administrative and support service activities	-0.25 (0.68)	0.20	0.78	2.98
Education	1.27 (0.71)	0.89	3.56	14.22
Human health and social work activities	**1.58** (0.52)**	**1.74**	**4.84**	**13.42**
Other sectors	0.56 (0.48)	0.70	1.76	4.43
Company size. Baseline: LT 20. GE 20 LT 200	0.30 (0.43)	0.58	1.35	3.12
GE 200 LT 2000	0.86 (0.45)	0.98	2.36	5.68
GE 2000	**0.93* (0.46)**	**1.02**	**2.53**	**6.28**
Affection by the minimum wage introduction	-0.44 (0.33)	0.34	0.65	1.25
Labor income	0.00 (0.00)	1.00	1.00	1.00
Job tenure	0.00 (0.02)	0.95	0.99	1.03
Job complexity	**0.66*** (0.17)**	**1.40**	**1.93**	**2.67**
Contract duration	0.11 (0.40)	0.51	1.11	2.42
Employment form. Baseline: Full-time employment. **Part-time**	**-1.00** (0.40)**	**0.17**	**0.37**	**0.80**
Marginal employment	**-2.30*** (0.65)**	**0.03**	**0.10**	**0.35**
Education: formal degree. Baseline: Lower secondary education and below. Upper secondary education	-0.12 (0.62)	0.26	0.88	2.98
Post-secondary non-tertiary education	-1.39 (1.00)	0.03	0.25	1.78
Short-cycle tertiary education	0.54 (0.98)	0.25	1.72	11.78
Bachelors or equivalent level	-0.49 (1.06)	0.08	0.61	4.93
Masters or equivalent level and above	-2.04 (1.56)	0.01	0.13	2.77
Education: duration of studies	0.29 (0.16)	0.98	1.34	1.82
Work experience	0.02 (0.03)	0.96	1.02	1.09
Age	-0.02 (0.03)	0.91	0.97	1.04
Gender. Baseline: Female	**-0.81* (0.40)**	**0.20**	**0.45**	**0.98**
Migration background. Baseline: No migration background				
Direct migration background	-0.42 (0.47)	0.26	0.66	1.64
Indirect migration background	-0.60 (0.51)	0.20	0.55	1.51
Survey year. Baseline: 2014. 2015	-0.03 (0.23)	0.62	0.97	1.52
2016	-0.12 (0.23)	0.56	0.88	1.40
N	1353			
n	557			
Wald Chi2	84.44***			
Ll	-555.51			
lnsig2u	1.63			
sigma_u	2.26			
Rho	0.61			
LR test of rho=0. Chibar2(01)	110.37***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

The indicators employed for checking the statistical goodness of the model in the previous chapter remain valid in this case either. Wald Chi2 is significant at 0.001 level, as well as LR test of rho=0. The latter implies that similar to the employer-sponsored one, predicted training incidence is moderated by the panel-variance component and not only general impact of predictors. We also prove the correctness of the default number of iteration points and absence of multicollinearity (Tables 57, 62-64 in the Appendix).

For capturing the marginal associations between observed values of the dependent variable, we employ already introduced xtrho command (Table 20 below). Individual probabilities of participating in training at one of the occasion (19%) and at all the three occasions (10%) have increased in comparison to those of employer-sponsored one (11% and 5% respectively). Similar to the dynamics of variables on the individual level, this is a product of broadening the scope of training activities and observation period. The same reasons are behind a slight reduction in path dependency of training participation on 0.37 points (8.05-7.68) or 5% (0.37/8.05) in comparison to the corresponding value in the analysis of employer-sponsored training. It implies that training incidence at a given time point remains highly dependent on the individual learning behavior, also when investments other than employer are taken into account. Odds of training incidence at one occasion are 7.68 times higher for an individual who participated in training at the other occasion than for the one with the same characteristics who did not. This also implies the increase in the share of variation in training incidence in one of the survey years explained by the variation of the variable in the other one (squared Pearson correlation: 10% for employer-sponsored training incidence, 15 % for training incidence).

Table 20. Determinants of Training Incidence under the Minimum Wage Introduction: Measures of Association at Median Fixed Part of the Model

Measure	Estimate	95% CI	
		Upper	Lower
Marginal probability	0.19	0.16	0.23
Joint probability	0.10	0.07	0.14
Odds ratio	7.68	5.27	11.41
Pearson's r	0.39	0.29	0.49
Yule's Q	0.77	0.68	0.84

Source: SOEP Data 2014-2016, own calculations

Ranking predictors by comparing marginal effects (Table 21) and log-likelihoods based on adequacy principle (Table 22) produces partially contradictory scores. The highest positive impact is attributed to the affiliation to both indicated business sectors, whereas the most negative one to the marginal form of employment. These findings are plausible in terms of the effect of the minimum wage introduction on the macro and micro levels. Company size is according to both estimation methods of a moderate importance for predicting dependent variable. Gender is regarded to contribute the least to its variation according to adequacy principle ranking, whereas job complexity is regarded as one estimating average marginal effects. The source of the ranking discrepancies has been discussed in the compatible part of the previous chapter. We deepen the understanding of these differences by comparing groups upon single variables.

Table 21. Determinants of Training Incidence under the Minimum Wage Introduction: Average Marginal Effects

	dy/dx (SE)	95% CI	
		Lower	Upper
Firm location. Baseline: East Germany, incl. Berlin	0.05 (0.03)	-0.02	0.11
Business sector. Baseline: Manufacturing			
Wholesale and retail trade, repair of motor vehicles and motorcycles	0.00 (0.04)	-0.08	0.07
Accommodation and food service activities	0.06 (0.06)	-0.06	0.18
Transportation and storage	**0.17** (0.07)**	**0.04**	**0.30**
Administrative and support service activities	-0.02 (0.05)	-0.11	0.08
Education	0.12 (0.08)	-0.03	0.26
Human health and social work activities	**0.15** (0.05)**	**0.05**	**0.26**
Other sectors	0.05 (0.04)	-0.03	0.12
Company size. Baseline: LT 20			
GE 20 LT 200	0.02 (0.03)	-0.04	0.09
GE 200 LT 2000	**0.08* (0.04)**	**0.00**	**0.15**
GE 2000	**0.08* (0.04)**	**0.00**	**0.16**
Affection by the minimum wage introduction	-0.04 (0.03)	-0.10	0.02
Labor income	0.00 (0.00)	0.00	0.00
Job tenure	0.00 (0.00)	0.00	0.00
Job complexity	**0.06*** (0.01)**	**0.03**	**0.09**
Contract duration	0.01 (0.04)	-0.07	0.08
Employment form. Baseline: Full-time employment			
Part-time employment	**-0.10** (0.04)**	**-0.17**	**-0.03**
Marginal employment	**-0.18*** (0.04)**	**-0.25**	**-0.10**
Education: formal degree. Baseline: Lower secondary education and below			
Upper secondary education	-0.01 (0.06)	-0.13	0.11
Post-secondary non-tertiary education	-0.11 (0.08)	-0.27	0.05
Short-cycle tertiary education	0.06 (0.11)	-0.15	0.27
Bachelors or equivalent level	-0.05 (0.10)	-0.24	0.15
Masters or equivalent level and above	-0.14 (0.10)	-0.33	0.05
Education: duration of studies	0.03 (0.01)	0.00	0.05
Work experience	0.00 (0.00)	0.00	0.01
Age	0.00 (0.00)	-0.01	0.00
Gender. Baseline: Female	**-0.08* (0.04)**	**-0.14**	**0.00**
Migration background. Baseline: No migration background			
Direct migration background	-0.04 (0.04)	-0.12	0.04
Indirect migration background	-0.06 (0.05)	-0.13	0.03
Survey year. Baseline: 2014			
2015	0.00	-0.04	0.04
2016	-0.01	-0.05	0.03

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 22. Determinants of Training Incidence under the Minimum Wage Introduction: Ranking Predictors (Adequacy)

Single predictor included in the model	Ll	Wald Chi2
Model with all predictors included	*-555.51*	*84.44****
Business sector	**-646.94**	**34.57****
Job complexity	**-688.68**	**69.65****
Education: duration of studies	-696.63	32.12***
Education: formal degree	-718.18	32.60***
Labor income	-721.13	46.60***
Employment form	**-723.53**	**34.48****
Work experience	-731.58	0.21
Company size	**-737.86**	**16.39****
Affection by the minimum wage introduction	-742.39	10.31***
Job tenure	-743.38	8.62**
Contract duration	-745.38	4.00*
Migration background	-745.58	2.81
Firm location	-746.36	1.67
Gender	**-747.35**	**0.41**
Survey year	-746.48	2.13
Age	-747.53	0.83*

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Predictors that are significant in the complete model are marked with bold

Source: SOEP Data 2014-2016, own calculations

Before performing group comparisons, we formulate an interim conclusion upon newly introduced findings and their integration to those of the previous chapter. The above documented analysis has provided an understanding of the training incidence development and determinants on the minimum wage labor market, as well as broadened the perspective on employer-financed training. Training incidence dynamics remains unaffected by the changes in different sources of human capital investments observed in the previous chapter. This supports the limited evidences for the inter-compensation between different cost bearers and/or absence of the effect of the minimum wage introduction on training incidence. The range of regressors remain persistent in predicting the training incidence either; hence, firm and individual level workplace characteristics are in the first place in charge for any kind of human capital investments on the minimum wage labor market. Additionally, we observe a minor contribution of the personal characteristic, namely, gender. Concluding remarks upon these issues will be drawn after performing within- and between-group comparisons.

4.3.2. Predictors: Within and Between-Group Comparison. Interaction Effects

In this chapter we examine group-specific effects of independent variables employing already introduced interaction effects, average marginal effects and conditional-effects-plots. As we already approached the majority of the predictors and group variations introduced in this chapter, the repeating explanations are shortened. The starting point is the most powerful predictor, sectoral variation. Table 23 below shows that higher training incidence in the Human health and social work activities branch are attributed to the members of the control group, which has already been the case for employer-sponsored training. The finding is confirmed by comparing average marginal effects in the Table 24 that indicates 18% lower chances for training participation in the treatment group. The variation is consistent across the whole observation period, which partially proves its independence of the minimum wage introduction. No further sector and time-specific effects has been observed.

Table 23: Determinants of Training Incidence: Interaction Effects (Business Sector and Affection by the Minimum Wage Introduction)

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-6.65*** (1.99)	0.81	1.68	3.49
Firm location. Baseline: East Germany, incl. Berlin	0.52 (0.37)	0.87	1.69	3.93
Business sector. Baseline: Manufacturing # Control Group				
Wholesale and retail trade, repair of motor vehicles and motorcycles # Control Group	-0.14 (0.94)	0.14	0.87	5.54
Accommodation and food service activities # Control Group	-0.34 (1.19)	0.07	0.71	7.39
Transportation and storage # Control Group	0.63 (1.00)	0.26	1.87	13.26
Administrative and support service activities # Control Group	-1.11 (1.56)	0.02	0.33	7.08
Education # Control Group	0.94 (1.14)	0.28	2.56	23.81
Human health and social work activities # Control Group	**2.03** (0.82)**	**1.53**	**7.60**	**37.86**
Other sectors # Control Group	-0.20 (0.72)	0.20	0.82	3.35
Manufacturing # Treatment Group	-0.97 (0.69)	0.10	0.38	1.47
Wholesale and retail trade, repair of motor vehicles and motorcycles # Treatment Group	-0.80 (0.71)	0.11	0.45	1.82
Accommodation and food service activities # Treatment Group	0.33 (0.90)	0.24	1.39	8.19
Transportation and storage # Treatment Group	1.29 (0.81)	0.75	3.64	17.76
Administrative and support service activities # Treatment Group	-0.85 (0.84)	0.08	0.43	2.20
Education # Treatment Group	0.48 (0.90)	0.28	1.62	9.39
Human health and social work activities # Treatment Group	0.41 (0.72)	0.37	1.51	6.20
Other sectors # Treatment Group	0.17 (0.69)	0.31	1.19	4.62
Company size. Baseline: LT 20. GE 20 LT 200	0.31 (0.43)	0.59	1.36	3.14
GE 200 LT 2000	0.84 (0.45)	0.96	2.32	5.58
GE 2000	0.89 (0.47)	0.98	2.43	6.05
Labor income	0.00 (0.00)	0.99	1.00	1.01
Job tenure	0.00 (0.02)	0.96	1.00	1.04
Job complexity	**0.64*** (0.16)**	**1.38**	**1.91**	**2.63**
Contract duration	0.07 (0.40)	0.50	1.08	2.34
Employment form. Baseline: Full-time employment **Part-time employment**	**-1.04** (0.40)**	**0.16**	**0.35**	**0.77**
Marginal employment	**-2.27*** (0.64)**	**0.03**	**0.10**	**0.36**
Education: formal degree. Baseline: Lower secondary and below. Upper secondary	0.00 (0.62)	0.30	1.00	3.33
Post-secondary non-tertiary education	-1.25 (0.10)	0.04	0.29	2.02
Short-cycle tertiary education	0.71 (0.98)	0.30	2.03	13.89
Bachelors or equivalent level	-0.26 (1.06)	0.10	0.77	6.12
Masters or equivalent level and above	-1.79 (1.54)	0.01	0.17	3.40
Education: duration of studies	0.26 (0.16)	0.95	1.29	1.76
Work experience	0.02 (0.03)	0.95	1.02	1.08
Age	-0.03 (0.03)	0.91	0.97	1.04
Gender. Baseline: Female	**-0.79* (0.40)**	**0.21**	**0.45**	**0.99**
Migration background. Baseline: No migration background Direct migration background	-0.42 (0.47)	0.26	0.66	1.63
Indirect migration background	-0.62 (0.51)	0.20	0.54	1.46
Survey year. Baseline: 2014. 2015	-0.04 (0.23)	0.61	0.96	1.51
2016	-0.10 (0.23)	0.57	0.91	1.44
N	1353			
n	557			
Wald Chi2	89.16***			
Ll	-551.86			
lnsig2u	1.58			
sigma_u	2.20			
Rho	0.60			
LR test of rho=0. Chibar2(01)	101.52			

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 24. Training Incidence and Business Sector under the Minimum Wage Introduction: Average Marginal Effects (Between-Group Comparison)

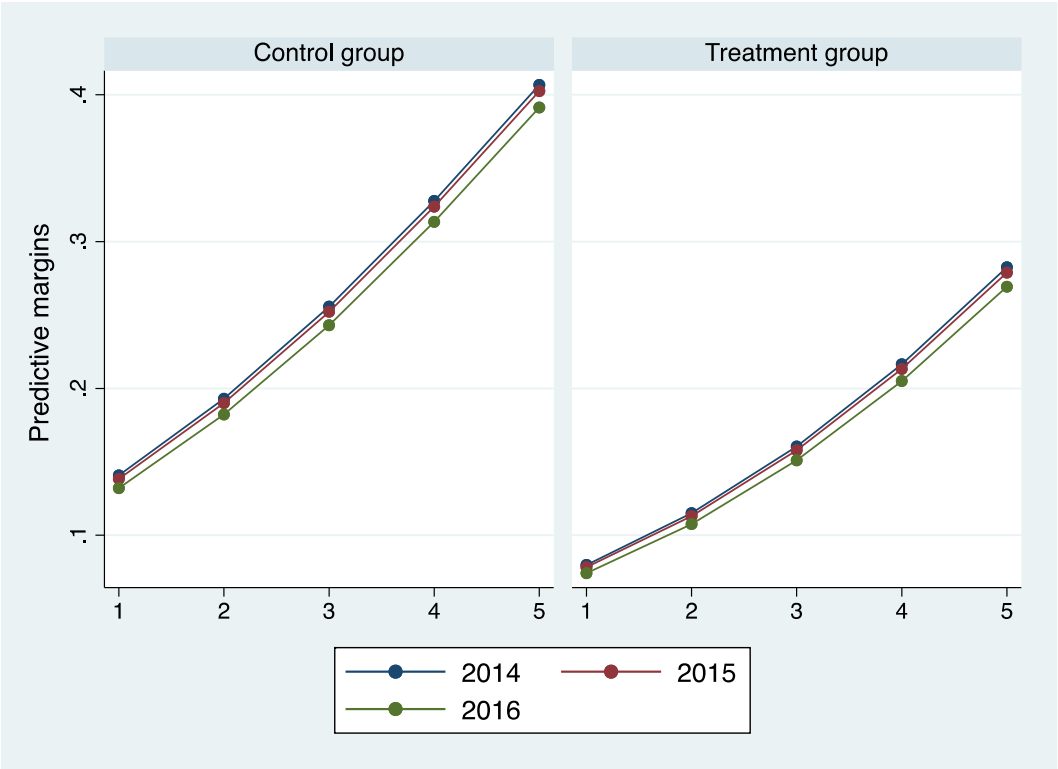
	2014	2015	2016
	Treatment group. Baseline: Control group		
Manufacturing	-0.08	-0.08	-0.08
Wholesale and retail, repair	-0.05	-0.05	-0.05
Accommodation and food service	0.06	0.06	0.06
Transportation and storage	0.07	0.07	0.07
Administrative and support service activities	0.02	0.02	0.02
Education	-0.05	-0.05	-0.05
Human health and social work activities	-0.18*	-0.18*	-0.18*
Other sectors	0.03	0.03	0.03

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

The effect of job complexity is best represented by conditional-effects-plot (Figure 7 below). On the one hand, it shows already inspected discrepancies in training incidence with regard to the wage adjustment point, slightly less articulated than in the case of employer-financed one. On the other hand, we do not find any heterogeneities in the annual comparison. Hence, no specific measures for training expansion for simple jobs has been overtaken with regard to the minimum wage law.

Figure 7. Training Incidence and Job Complexity under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

We do find a significant interaction effect for employment type (Table 25 below), indicating more profound vulnerability of the treatment group members employed on part-time and marginal jobs. Although the effect of both variables is same negative for the observations in the control group, it is not significant. Therefore, instability of atypical occupation forms for them might be compensated by learning opportunities and/or employee's motivation to qualify for better positions. These still remains minor in comparison to the full-time ones.

Table 25. Determinants of Training Incidence: Interaction Effects (Type of Employment and Affection by the Minimum Wage Introduction)

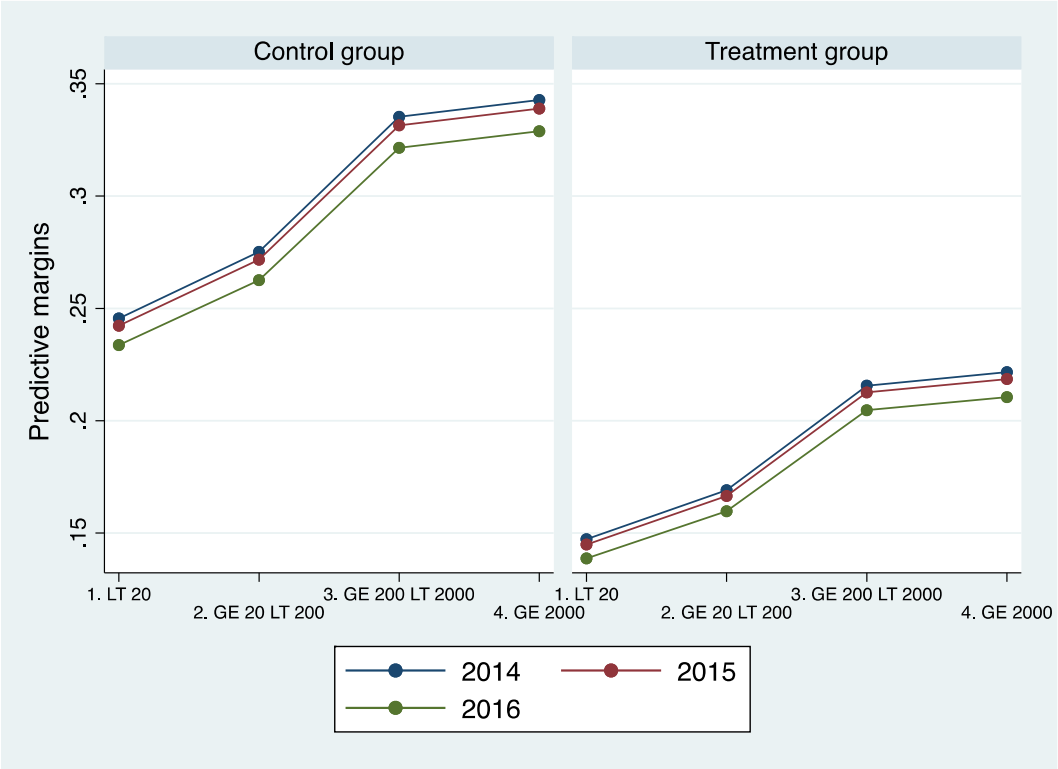
	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-7.20*** (2.00)	0.00	0.00	0.04
Firm location. Baseline: East Germany, incl. Berlin	0.54 (0.37)	0.82	1.71	3.56
Business sector. Baseline: Manufacturing				
Wholesale and retail trade, repair of motor vehicles and motorcycles	-0.04 (0.53)	0.34	0.96	2.72
Accommodation and food service activities	0.69 (0.70)	0.50	1.99	7.84
Transportation and storage	**1.70** (0.61)**	**1.64**	**5.45**	**18.09**
Administrative and support service activities	-0.25 (0.68)	0.20	0.78	2.98
Education	1.26 (0.71)	0.89	3.54	14.16
Human health and social work activities	**1.57** (0.52)**	**1.73**	**4.82**	**13.40**
Other sectors	0.56 (0.47)	0.69	1.75	4.42
Company size. Baseline: LT 20. GE 20 LT 200	0.30 (0.43)	0.58	1.35	3.14
GE 200 LT 2000	0.86 (0.45)	0.99	2.37	5.72
GE 2000	**0.93* (0.47)**	**1.02**	**2.54**	**6.31**
Labor income	0.00 (0.00)	0.99	1.00	1.01
Job tenure	-0.01 (0.02)	0.95	0.99	1.03
Job complexity	**0.66*** (0.17)**	**1.39**	**1.93**	**2.67**
Contract duration	0.10 (0.40)	0.51	1.11	2.41
Employment form. Baseline: Full-time employment # Control group				
Part-time employment # Control group	-0.96 (0.64)	0.11	0.38	1.33
Marginal employment # Control group	-2.11 (1.12)	0.01	0.12	1.10
Full-time employment # Treatment group	-0.40 (0.39)	0.31	0.67	1.45
Part-time employment # Treatment group	**-1.42 (0.52)**	**0.09**	**0.24**	**0.66**
Marginal employment # Treatment group	**-2.78 (0.77)**	**0.01**	**0.06**	**0.28**
Education: formal degree. Baseline: Lower secondary education and below				
Upper secondary education	-0.12	0.26	0.89	2.99
Post-secondary non-tertiary education	-1.39 (1.00)	0.03	0.25	1.78
Short-cycle tertiary education	0.54 (0.98)	0.25	1.72	11.80
Bachelors or equivalent level	-0.48 (1.07)	0.08	0.62	4.98
Masters or equivalent level and above	-2.03 (1.56)	0.01	0.13	2.80
Education: duration of studies	0.29 (0.16)	0.98	1.34	1.82
Work experience	0.02 (0.03)	0.96	1.02	1.09
Age	-0.03 (0.03)	0.91	0.97	1.04
Gender. Baseline: Female	**-0.81* (0.40)**	**0.20**	**0.44**	**0.98**
Migration background. Baseline: No migration background Direct migration background	-0.03 (0.23)	0.26	0.66	1.64
Indirect migration background	-0.60 (0.51)	0.20	0.55	1.50
Survey year. Baseline: 2014. 2015	-0.03 (0.23)	0.62	0.97	1.52
2016	-0.13 (0.24)	0.56	0.88	1.40
N	1353			
n	557			
Wald Chi2	84.28***			
Ll	-555.49			
lnsig2u	1.63			
sigma_u	2.26			
Rho	0.61			
LR test of rho=0. Chibar2(01)	110.41***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

The effect of the company size on the training incidence independently of the cost bearer is identical to the one for the employer-sponsored training discussed in the chapter 4.2.2, except for the absence of profound time-specific trends.

Figure 8. Training Incidence and Company Size under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

Higher training incidence for women in the contradiction to the patterns of the human capital theory allows for inspection of gender-specific trends on the minimum wage labor market. With regard to the wage adjustment point, the major effect is attributed to the significant negative effect for the men in the treatment group in comparison to the women in the control group (Table 25 below). Remarkably, controlling for that diminishes the effect of the company size on the dependent variable. Nevertheless, no significant marginal effects have been found in between- and within-group comparisons upon wage adjustments.

Table 26. Determinants of Training Incidence: Interaction Effects (Gender and Affection by the Minimum Wage Introduction)

	B (SE)	95% CI for Odds Ratio		
		Lower	OR	Upper
Constant	-7.63*** (2.03)	0.00	0.00	0.03
Firm location. Baseline: East Germany, incl. Berlin	0.57 (0.37)	0.85	1.78	3.70
Business sector. Baseline: Manufacturing				
Wholesale and retail trade, repair of motor vehicles and motorcycles	-0.03 (0.53)	0.34	0.97	2.75
Accommodation and food service activities	0.72 (0.70)	0.52	2.06	8.11
Transportation and storage	**1.71** (0.61)**	**1.67**	**5.56**	**11.48**
Administrative and support service activities	-0.23 (0.69)	5.56	0.79	18.48
Education	1.27 (0.71)	0.89	3.58	3.03
Human health and social work activities	**1.63** (0.52)**	**1.83**	**5.08**	**14.16**
Other sectors	0.57 (0.47)	0.70	1.76	4.45
Company size. Baseline: LT 20. GE 20 LT 200	0.26 (0.43)	0.56	1.30	3.01
GE 200 LT 2000	0.83 (0.45)	0.96	2.30	5.52
GE 2000	0.89 (0.46)	0.98	2.44	6.08
Labor income	0.00 (0.00)	0.99	1.00	1.01
Job tenure	-0.01 (0.02)	0.96	0.99	1.03
Job complexity	**0.67*** (0.17)**	**1.41**	**1.95**	**2.70**
Contract duration	0.09 (0.40)	0.50	1.10	2.39
Employment form. Baseline: Full-time employment				
Part-time employment	**-1.04** (0.40)**	**0.16**	**0.35**	**0.78**
Marginal employment	**-2.34*** (0.65)**	**0.03**	**0.10**	**0.34**
Education: formal degree. Baseline: Lower secondary education and below				
Upper secondary education	-0.13 (0.62)	0.26	0.88	2.97
Post-secondary non-tertiary education	-1.45 (1.01)	0.03	0.23	1.68
Short-cycle tertiary education	0.54 (0.98)	0.25	1.72	11.81
Bachelors or equivalent level	-0.53 (1.07)	0.07	0.59	4.76
Masters or equivalent level and above	-1.93 (1.56)	0.01	0.14	1.04
Education: duration of studies	0.29 (0.16)	0.98	1.34	1.83
Work experience	0.02 (0.03)	0.95	1.02	1.09
Age	-0.03 (0.03)	0.91	0.97	1.04
Gender. Baseline: Female # Control group				
Female # Treatment group	-0.01 (0.45)	0.40	0.99	2.40
Male # Control group	-0.25 (0.57)	0.26	0.78	2.39
Male # Treatment group	**-1.15* (0.52)**	**0.11**	**0.32**	**0.89**
Migration background. Baseline: No migration background Direct migration background	-0.39 (0.47)	0.27	0.67	1.68
Indirect migration background	-0.56 (0.51)	0.21	0.57	1.56
Survey year. Baseline: 2014. 2015	-0.03 (0.23)	0.62	0.97	1.52
2016	-0.13 (0.24)	0.56	0.88	1.40
N	1353			
n	557			
Wald Chi2	85.13***			
Ll	-554.58			
lnsig2u	1.63			
sigma_u	2.26			
Rho	0.61			
LR test of rho=0. Chibar2(01)	110.86***			

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculation

We proceed with the discussion of gender heterogeneities across the above indicated significant predictors. Namely, we find a persistent significant negative effect for men in all the examined sectors, except for Manufacturing and Administrative and support service activities. One possible explanation behind is the fact that men are more likely to perform manual and/or physically demanding [less knowledge intense] tasks, with less opportunities and need for further qualification. This finding could be partially supported by the absence of gender-specific differences when controlling for the job complexity (Figure 15 in the Appendix). On the other hand, there is a statistically significant dependence between sectoral distribution of employees and their gender (Table 69 in the Appendix). Namely, the negative effect for men is absent in the Manufacturing branch, which is clearly male-dominated. In the female-dominated sectors, both firms and workers possibly see employment opportunities for women as more favorable and/or long-term ones, which results in the higher rates of human capital investments for them.

Table 27. Gender and Business Sector - Training Incidence under the Minimum Wage Introduction: Average Marginal Effects (Between-Group Comparison)

	2014	2015	2016
	Male. Baseline: Female		
Manufacturing	-0.06	-0.06	-0.06
Wholesale and retail, repair	-0.06*	-0.06*	-0.06*
Accommodation and food service	-0.08*	-0.08*	-0.08*
Transportation and storage	-0.09*	-0.09*	-0.09*
Administrative and support service activities	-0.06	-0.06	-0.06
Education	-0.08*	-0.08*	-0.08*
Human health and social work activities	-0.09*	-0.09*	-0.09*
Other sectors	-0.07*	-0.07*	-0.07*

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Perception of employment opportunities on the minimum wage labor market as well as nature of jobs are also applicable for explaining gender differences in training provision across three indicated employment forms (Table 28 below). Namely, significant negative effect for men is observed by full-time and part-time employment, whereas mini-jobs lack learning opportunities for both genders.

Table 28. Gender and Employment Form - Training Incidence under the Minimum Wage Introduction: Average Marginal Effects (Between-Group Comparison)

	2014	2015	2016
	Male. Baseline: Female		
Full-time employment	-0.08*	-0.08*	-0.08*
Part-time employment	-0.07*	-0.07*	-0.06*
Marginal employment	-0.04	-0.04	-0.04

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 29 below summarizes the above documented findings.

Table 29. Overall, Within- and Between-Groups Effects of Significant Predictors of Training Incidence under the Minimum Wage Introduction

Predictor	Value	Impact: Baseline model	Between-group differences	Gender differences
Business sector	*Manufacturing*	Baseline category	No	No
	Transportation and storage	Highest training incidence in sectoral comparison	No	Yes
	Human health, social work	Second highest training incidence in sectoral comparison	Yes	Yes
Job complexity	*1-5*	Positive impact on dependent variable	Yes	No
Type of employment	*Full-time*	Baseline category	No	Yes
	Part-time	Second lowest chances of training participation in cross-type comparison	Yes	Yes
	Marginal	Lowest chances of training participation in cross-type comparison	Yes	No
Company size	*LT 20*	Baseline category	Yes	No
	GE 200 LT 2000	Significant positive average marginal effect		
	GE 2000	Highest rate of training participation in cross-category comparison		
Gender	*Male and Female*	Lower training incidence for men	Yes	-

Source: Chapters 4.3.1-4.3.2 of the paper

The predicted variation on the basis of wage adjustment point is less articulated by training incidence independently of the training cost bearer but is still present. Namely, we have observed lower rates of training provision for the members of the treatment group in Human health and social work activities sector, on part-time and marginal positions, on the basis of job complexity, company size and gender. These are also the important variables for describing the affection by the minimum wage introduction on different levels. Hence, we cannot reject the hypothesis for the relevance of the law for training opportunities and inter-compensation between different sources for financing them. Nevertheless, we have not found any significant change in the dependent variable in an annual perspective, which, in its absolute terms, means the absence of the effect of minimum wage introduction on training incidence. The current analysis also broadens the understanding of the minimum wage labor market, namely from the gender perspective. In contradiction to the human capital theory, we have indicated lower training incidence for men that remains persistent in the sectoral variation and on the basis of employment form.

4.2.3. Minimum Wage Introduction and Training Incidence: Interim Conclusion

The second part of analysis has not indicated a significant effect of the minimum wage introduction on training incidence in the annual comparison. We do find the evidences for its variation with regard to the wage adjustment point in the within-group perspective. The current analysis fulfills the functions of both inspection of training participation trends independently of the cost bearer and identifying unique predictors of firm human capital investments on the minimum wage labor market. Hence, we summarize the findings of the chapter in a retrospective with the employer-sponsored training incidence.

Participation in employer-financed training as well as in training activities of any cost bearer is priory predicted on a sectoral level. Namely, the highest rates of both are observed in the Transportation and storage and Human health and social work activities branches. Both follow the same patterns of within-group variation with regard to the wage adjustment point. All kinds of human capital investments face the identical influence of job complexity, size of employing company and type of employment. The statistical significance of these variables indicates the consistency of the findings with the human capital theory. We also inspect within-group trends, which indicate the direct relevance of the latter for the investments on the minimum wage labor market.

Performance-related indicators (formal degree of education and education duration) have an impact on employer-sponsored training only. In this case they perform a signal function for employee's ability for the firm, but do not affect significantly training participation. Again, the relevance of inter-compensation explanation is proven, meaning that employees with lower formal degrees are likely to compensate for the lack of employer investments by own and/or third-party ones. At the same time, personal characteristic (gender) does affect training incidence but has no impact on employers' investment decision. For both patterns respective explanations have been discussed in detail.

At this point of analysis, we have documented a positive effect of the minimum wage introduction on employer-sponsored training opportunities for the affected workers, shortly before the law officially comes into force. This is, however, not significant for training incidence for activities at any cost. We also find persistent discrepancies on the basis of wage adjustment point. Nevertheless, their causality has double interpretation, for which we also address. The answer to the stated research question remains incomplete without inspecting training intensity, which is performed in the next chapter.

4.4. Training Intensity under the Minimum Wage Introduction in Germany

4.4.1. Dynamics and Predictors of Training Intensity

The current chapter presents the final step of the analysis of the minimum wage outcomes on training in Germany. There is no strict theoretical framework developed with regard to the differentiated impact of the law on incidence and intensity for the reasons discussed in the second chapter. The majority of the sited sources suggest measuring training intensity for participants only, to ensure the independence of measurements from ones of training expansion that is already controlled by training incidence indicators. This approach places the focus on the strategies of training provision and participation behavior; though on the cost of significant sample reduction (Table 70 of the Appendix). We use two separate indicators for training intensity. Number of enrollments stands for the variety of training provision (width) when assuming that each training measure differs in the content. Though, this cannot be proven by the current data. Training volume is an indicator of training amount or depth for single events. The patterns of human capital theory remain valid for both; hence, parallel review will ensure the clear presentation of results.

First, we present the basic descriptive statistics on both dependent variables within the observation period. When calculating the number of enrollments (Table 30), training provision appears to be one of a relatively low intensity. Participating in training only once a year is the most widespread form by between-group and annual comparisons. The range of its percentages lay between 32 (15/46) in 2014 and 42 (22/53) in 2015 for the control group; and 41 (29/70) in 2016 and 43 (31/72) in 2014 for the treatment group. Participating in training twice a year is slightly less common and is the second most widespread. Hence, for both groups average number of training occasions per year does not go beyond 3 per participant and beyond 1 per person in both groups. On the other hand, the amount of provided training delivers slightly different perspective on the intensity pattern (Table 31), mainly due to its within-group heterogeneity. Its high dispersion of low (1-2 days) and high training volumes (8-20 days) is observed in the treatment group, whereas the distribution of the observations in the control group is more normalized. Training volume does not fall below 10 days per participant per year and reaches the maximum of almost 17 days for the treatment group (2014) and almost 16 days for the control group (2015). Therefore, we conclude upon the relatively long training duration under the low number of overtaken further education events.

Table 30. Number of Enrollments and the Minimum Wage Introduction in Germany: Frequencies and Descriptive Statistics

	2014		2015		2016	
	Control group	Treatment group	Control group	Treatment group	Control group	Treatment group
1 measure	15	31	22	32	16	29
2 measures	13	19	9	21	9	19
3 measures	6	6	7	9	11	9
4 measures	5	4	7	7	6	3
5 measures and more	7	12	8	4	3	11
Mean (Participants)	2.59	2.49	2.74	2.18	2.38	2.56
Mean (All)	0.75	0.51	0.76	0.36	0.72	0.51

Source: SOEP Data 2014-2016, own calculations

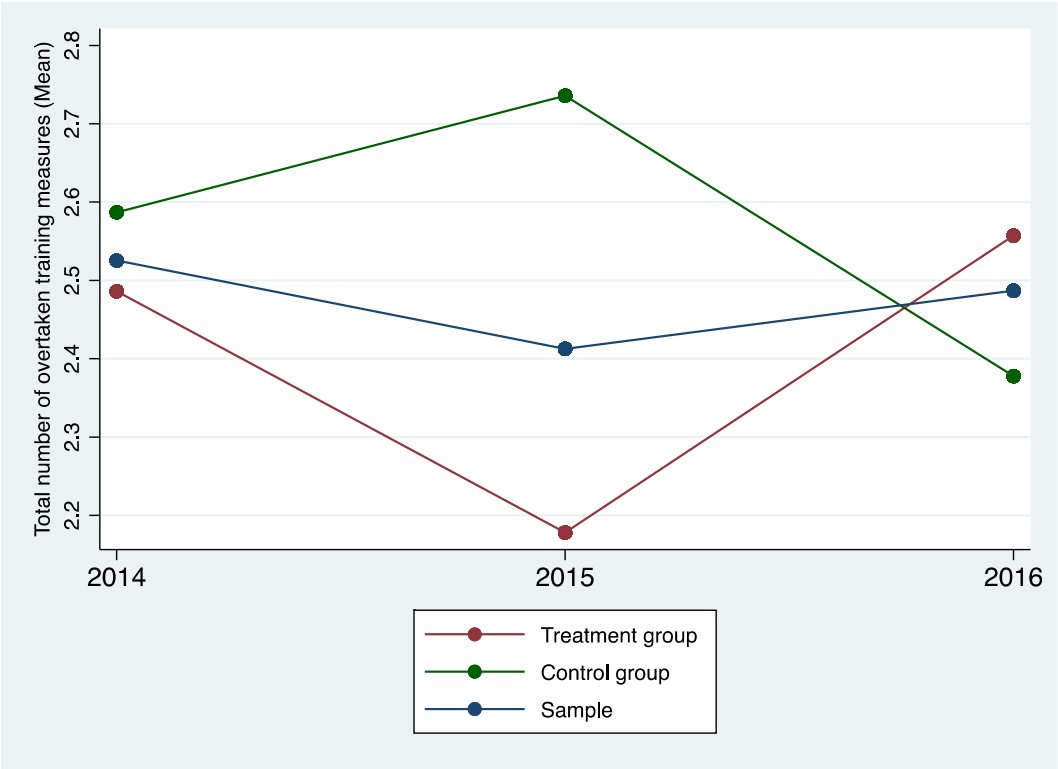
Table 31. Training Volume under the Minimum Wage Introduction in Germany: Frequencies and Descriptive Statistics

	2014		2015		2016	
	Control group	Treatment group	Control group	Treatment group	Control group	Treatment group
1 day	3	6	7	7	6	13
2 days	6	10	5	19	6	13
3 days	6	5	6	9	9	5
4 days	10	4	5	9	3	7
5 days	8	13	6	4	7	10
6 days	3	7	3	1	1	2
7 days	1	3	1	3	0	1
8-20 days	5	12	13	13	11	13
21-50 days	3	7	4	3	0	4
More than 50 days	1	5	3	5	2	2
Mean (Participants)	10.61	16.93	15.77	11.62	10.60	10.46
Mean (All)	3.09	3.50	4.40	1.92	3.62	2.07

Source: SOEP Data 2014-2016, own calculations

Visualizing two central concepts (number of enrollments) and training volume (number of days in training) per participant makes the different patterns of their change as well as within- and between-group differences clear. The mean of training activities (Figure 9) has dramatically decreased in the treatment group shortly before the law introduction (survey year 2015) under its slight increase for training participants in the control group. After the law officially comes into force (survey year 2016), an opposite process is observed. Namely, the number of enrollments increases clearly for the participants in the treatment group and decreases for those in the control group.

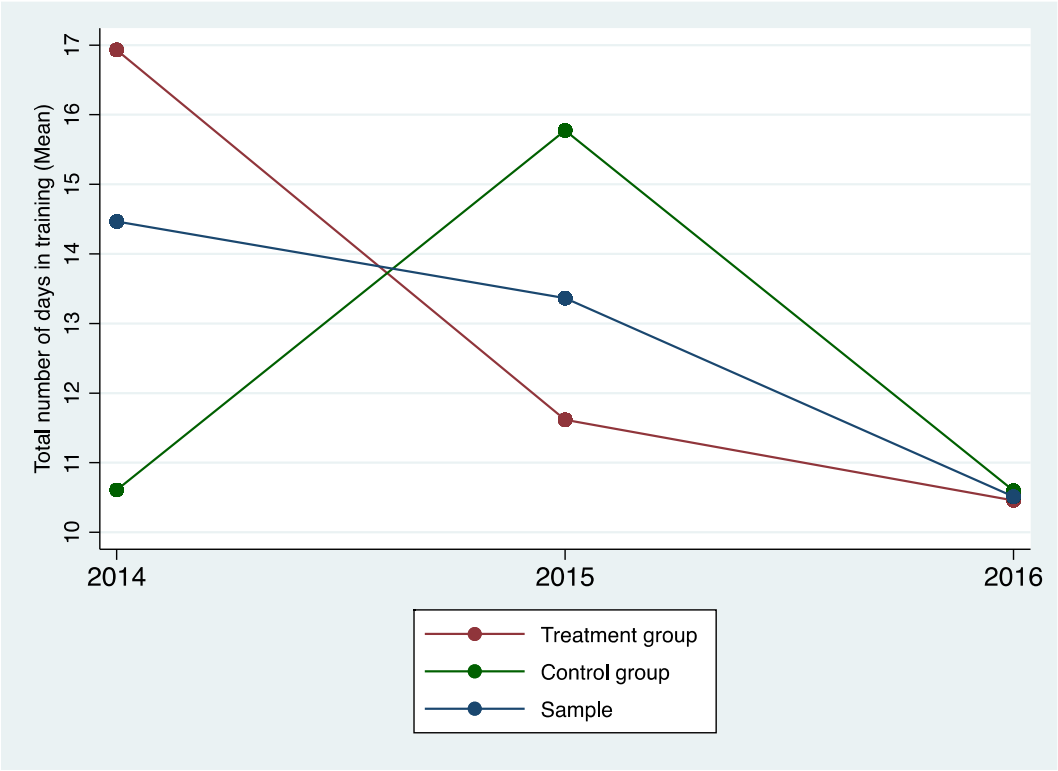
Figure 9. Number of Enrollments under the Minimum Wage Introduction in Germany: Mean Value (Participants)



Source: SOEP Data 2014-2016, own calculations

The Figure 10 below presents an overview of the development of training volume per participant within the observation period. Remarkably, before the law introduction (survey year 2014) it is clearly higher in the treatment than in the control group, following the pattern of change for the number of enrollments for 2015. The gradual fall in the average training volume is observed in the treatment group. Official implementation of the minimum wage (survey year 2016) resembles the measurements in the sample. We postpone interpretations of described tendencies before their statistical significance is proved.

Figure 10. Training Volume under the Minimum Wage Introduction in Germany: Mean Value (Participants)



Source: SOEP Data 2014-2016, own calculations

We perform an effort to combine both measurements on a descriptive basis calculating an average duration of training events (Table 32 below). Its dominant majority takes no longer than two days for both groups within the observation period. Again, the maximums are indicated for the measurements of the control group in 2015 (slightly less than two weeks) and for treatment group in 2014 (almost 13 days), whereas other values are placed around 8. Hence, it is impossible to formulate an unambiguous characteristic of training intensity dynamics through synthesis of two concepts. We also do not find any significant correlations for statistical modelling of their relationship. To sum it up, the current descriptive statistics provide only a limited proof for the increase in training duration when the number of enrollments decreases.

Table 32. Average Duration of Training Events (Rounded) under the Minimum Wage Introduction in Germany: Frequencies and Descriptive Statistics

	2014		2015		2016	
	Control group	Treatment group	Control group	Treatment group	Control group	Treatment group
Less than 1 day	1	0	2	0	0	0
1-2 days	30	39	31	44	31	49
3-7 days	9	19	8	17	9	13
8-20 days	4	5	7	5	3	3
21-50 days	1	4	2	3	0	3
More than 50 days	1	5	3	4	2	2
Mean (per Event)	7.95	13.94	12.82	8.12	8.12	7.29

Source: SOEP Data 2014-2016, own calculations

Further alternative for the descriptive analysis of the change in training intensity on the annual comparison basis is calculating the total overtaken number of training measures and days (Tables 33 and 34). The absolute numbers provide a very general overview of the concepts due to within- and between group differences in the number of cases. The dynamics of both concepts repeats the one of the respective mean values (Figures 9 and 10). Namely, a clear increase of 22% ((145-119)/119) in the total number of overtaken training measures by the members of the control group is observed in 2015 survey year; followed by the return to the level of 2014. The opposite tendency of 11% ((179-159)/159) single decrease in the variable is present for the treatment group. For the training volume, a major 71% ((836-488)/488) increase takes place for the control group; whereas total number of days in training is gradually falling in the treatment one. Whereas the dynamic has almost no impact on the shares of group sums in the total number of overtaken training activities in the sample [with regard to the number of observations]; it does have an effect for the training volume measures. At their maximum point of 2014 survey year, 73% (1289/1777) of the whole training volume is assigned to the treatment group members. The proportion is decreasing due to the above described dynamics.

Table 33. Total Number of Enrollments under the Minimum Wage Introduction in Germany: Sum

	2014	2015	2016
Control group	119	145	107
Treatment group	179	159	179
Total	**298**	**304**	**286**

Source: SOEP Data 2014-2016, own calculations

Table 34. Annual Training Volume under the Minimum Wage Introduction in Germany: Sum

	2014	2015	2016
Control group	488	836	477
Treatment group	1289	848	732
Total	**1777**	**1684**	**1209**

Source: SOEP Data 2014-2016, own calculations

Before we model the statistical change in training intensity, a short notice on its predictors is needed, as several transformations have been done in comparison to the random effects logistic regression. Namely, nominal variables have been recoded into dummy variables to estimate the impact of their change instead of one if its actual value. This was not needed for ordinal and metric variables. As it has been discussed in the Research Design, due to the limitations of the method, the impact of several predictors cannot be quantified and is, therefore, treated as an unobserved unit effect. The latter, in its turn, refers to the major advantages of First Differences Regression.

Table 71 in the Appendix provides a descriptive overview of the changes frequencies of the valid difference scores for the regressors and outcomes. Those do not reflect the discussed employment outcomes of the minimum wage law accurately due to the selectivity of the balanced panel construction approach. As estimating the direction and magnitude of their impact on the dependent variables [without representative conclusions upon the fact of occurrence] is the current research objective, we apply the sample for further analysis. We differentiate the descriptive statistics across the observation periods pairwise, as it is later applied in the regressions.

With regard to the presented changes, number of enrollments is slightly less sensitive to annual adjustments than the training volume, still under the high variation of both. Namely, the change in the number of enrollments covers between 54% and 79% of the members of the treatment group and between 69% and 78% of those in the control group. Remarkably, its highest rate takes place under the most stability in the number of overtaken training measures in the treatment group (survey years 2015-2016). Training volume is showing greater annual dynamics and its incidence clearly varies between groups either (79%-88% in the treatment group; 76%-94% in the control group). Adjustments of the duration of training events are more common when their number remains stable than the other way around (Tables 72 and 73 of the

Appendix). This appears logical, as changing shortening or prolonging single courses is of a lower financial and organizational costs than their organization.

Apart from the wage adjustment fact, which is the central change with regard to the stated research question, widespread within-unit variation is observed by the labor income. Inclusion of both variables is necessary, as the latter stands for measuring the magnitude of the income increase. Due to the nature of the method, variables of work experience and job tenure measure the effect of occupational transitions and career breaks within the employment history for the first variable, and with regard to the current employer for the second variable. For the dominant majority of the respondents those were absent. Within the 2015-2016 observation period, business sector and company size transitions are more frequent. Those could be attributed both to individual- and firm-level adjustments. Following the previously established analytical procedure, we first build the common model for the sample and deepen their findings through within- and between-group comparisons.

Table 35 below shows the application of First Differences Regression as suggested by Allison (2009) for the change in training intensity calculated as the number of overtaken further education events per year. *Wage adjustment* between 2014 and 2015 [modelled as one unit increase in the affection by the minimum wage introduction variable] increases the mean of the total number of training events for 1.88 in 2015-2016 survey years' comparison. Controlled for other time-varying predictors, it explains 15% of the variation in the dependent variable (R^2=0.15) indicating the major importance of further factors for human capital investments. The magnitude of the described effect decreases to 0.51, when modelling the link between 2014-2015 and 2015-2016 changes and accounting for the dependence of the measurements at three time points [last column]. In terms of the standardized regression coefficients (Table 36), we estimate the effect sizes (Cohen 1988). The observed medium effect directly after the law implementation is the result of its enhancement by the wage increase (Beta=0.33); whereas throughout the whole observation period it remains small (Beta=0.10).

In a limited longitudinal perspective, the impact of firm-level characteristics overcomes the one of the wage adjustment. Their change could be attributed both to company restructuring and individual employment decisions. *Switching the business sector* has a significantly positive effect (B=0.94) of a little strength (Beta=0.14) on the number of enrollments. It most probably reflects an increased need to acquire new skills in a different occupational branch. *Switching to a larger company* has a significant negative effect (B=-0.86) on the total number of overtaken training activities. With the highest value of the standardized coefficient (Beta=-0.26), it becomes the strongest predictor of training participation within the constructed model.

Table 35. Determinants of the Change in the Number of Enrollments under the Minimum Wage Introduction: First Differences Regression

	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
	B (SE)	B (SE)	B (SE)	B (SE)
Constant	0.31 (2.00)	-0.54 (1.37)	1.25 (2.01)	-0.26 (0.38)
Firm location	0.06 (2.18)	0.00 (0.00)	0.57 (3.00)	-0.69 (2.59)
Business sector	-0.05 (2.18)	0.83 (0.82)	1.25 (0.83)	**0.94*** (0.25)**
Company size	0.55 (0.41)	0.05 (0.46)	-0.61 (0.56)	**-0.86*** (0.16)**
Affection by the minimum wage introduction	-1.08 (0.55)	**1.88** (0.74)**	0.41 (0.75)	**0.51*** (0.12)**
Labor income	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Job tenure	-0.36 (1.17)	0.03 (0.12)	-0.06 (0.30)	0.01 (0.06)
Job complexity	0.07 (0.52)	-0.19 (1.75)	0.17 (0.79)	-0.04 (0.28)
Contract duration	0.15 (0.96)	-0.77 (1.66)	0.58 (2.83)	-0.10 (0.59)
Employment form	-1.33 (1.29)	-0.71 (1.74)	-1.09 (1.63)	-1.09 (0.65)
Work experience	0.59 (1.05)	-0.57 (1.32)	0.41 (0.92)	0.03 (0.25)
N	65	65	55	130
R^2	0.14	0.15	0.10	
Equation dummy				0.04 (0.56)
Wald Chi2				**81.74***

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 36. Determinants of the Change in the Number of Enrollments under the Minimum Wage Introduction: First Differences Regression (Standardized Coefficients)

	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
	Beta	Beta	Beta	Beta
Firm location	0.00	0.00	0.03	-0.03
Business sector	0.00	0.13	0.23	**0.14***
Company size	0.18	0.01	-0.17	**-0.26***
Affection by the minimum wage introduction	-0.26	**0.33**	0.08	**0.10***
Labor income	0.06	0.16	0.00	0.04
Job tenure	-0.06	0.05	-0.04	0.01
Job complexity	0.02	-0.02	0.04	-0.01
Contract duration	0.02	-0.08	0.04	-0.01
Employment form	-0.14	-0.05	-0.12	-0.09
Work experience	0.08	-0.05	0.08	0.00
Equation dummy				0.01

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Tables 37 and 38 below prove greater variation of training volume thought the panel spaces, already previously indicated in the descriptive statistics. Namely, we find a significant

decrease of 38.34 [intercept] days in training for an individual in the *control group* for whom *other selected characteristics did not change* within 2015-2016 survey years. Its domination over statistically insignificant increase between 2014 and 2015 survey years is proven by the trend effect of -21.37 in the last column. We find an unusually high persistent negative effect of changing the firm location from West to East Germany, attributed to a single influential case. Therefore, we omit it in the main body of findings and proceed with the remaining predictors.

There are several further implications on training volume with regard to the change in the job- and performance-related, as well as firm-level characteristics. On the contrary to the number of enrollments, we find a significantly positive effect of *switching to a larger company*. Combining two indicators, we conclude that larger companies tend to offer less further education events, but those of a longer duration. The finding could be assigned to the specificity of work in small firms discussed in the theoretical overview. In particular, employees there tend to fulfill the broader variety of tasks, hence, more shorter training events are needed. Instead, workers of large companies are more specifically focused on their field of functions and their further education is, therefore, more depth-oriented.

In addition to this, we observe a contradicting effect of *job tenure* and *work experience* variables in the four constructed models. Namely, prior to the law implementation, mastering firm-specific skills has been of a major importance for predicting training participation intensity; and higher training volumes are attributed to the persons having gained less of them. Namely, each extra year of work by the current employer is associated with an estimated decrease in the expectation of training volume of -12.94. After the law implementation, industry- and/or individual-specific (general) skills additionally controlled by work experience are with the effect size of 36.94 and 22.09 beneficial for further human capital investments, slightly dominating over the impact of firm-level characteristics. The difference might reflect the fact that prior to the labor price increase improving already established production process is more economically reasonable than innovations, and therefore, more urgent for the employer to generate the additional income for salaries in advance. Therefore, newly recruited employees enjoyed the most human capital investments and/or showed higher training initiative under the fear of losing the current workplace. After the law implementation, strategic human resource development through higher investment level by abler [more experienced] persons regulates intensity of training participation instead. The effect sizes for the observed standardized coefficients are placed in the same range between small and medium.

Table 37. Determinants of the Change in the Training Volume under the Minimum Wage Introduction: First Differences Regression

	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
	B (SE)	B (SE)	B (SE)	B (SE)
Constant	9.74 (8.03)	**-38.34* (16.17)**	0.43 (6.62)	**-21.37*** (8.02)**
Firm location	**-196.80*** (8.76)**	0.00 (0.00)	**-167.13*** (9.86)**	**-184.72*** (24.14)**
Business sector	-11.58 (8.76)	10.49 (9.60)	3.12 (2.73)	5.25 (6.25)
Company size	0.28 (1.65)	**11.59* (5.41)**	-3.38 (1.83)	**7.30** (2.92)**
Affection by the minimum wage introduction	-3.86 (2.22)	-0.92 (8.69)	2.96 (2.46)	-1.73 (4.24)
Labor income	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Job tenure	**-12.94** (4.70)**	-0.09 (1.37)	0.20 (0.99)	-0.14 (0.77)
Job complexity	-0.35 (2.09)	-6.09 (20.59)	3.35 (2.59)	0.45 (5.18)
Contract duration	4.26 (3.86)	5.47 (19.52)	9.79 (9.31)	5.33 (8.15)
Employment form	1.34 (5.17)	-3.70 (20.50)	-2.28 (3.37)	-3.13 (10.03)
Work experience	3.60 (4.21)	**36.94* (15.59)**	-1.72 (3.01)	**22.09*** (7.47)**
N	65	65	55	130
R^2	0.91	0.18	0.91	
Equation dummy				-3.43 (4.66)
Wald Chi2				**86.56***

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 38. Determinants of the Change in the Training Volume under the Minimum Wage Introduction: First Differences Regression (Standardized Coefficients)

	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
	Beta	Beta	Beta	Beta
Firm location	**-0.94***	0.00	**-0.89***	**-0.74***
Business sector	-0.08	0.14	0.06	0.06
Company size	0.01	**0.28***	-0.09	**0.18**
Affection by the minimum wage introduction	-0.07	-0.01	0.06	-0.03
Labor income	0.01	0.00	0.09	0.02
Job tenure	**-0.17**	-0.01	0.01	-0.01
Job complexity	-0.01	-0.04	0.07	0.01
Contract duration	0.05	0.05	0.07	0.05
Employment form	0.01	-0.02	-0.02	-0.02
Work experience	0.04	**0.30***	-0.03	**0.22***
Equation dummy				-0.06

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Due to the fact that the regression models of each panel space are calculated on the basis of different datasets, we are able to compare standardized coefficients within columns only.

Similar to the training incidence, its intensity is mainly determined by the workplace characteristics. Whereas firm-level ones are clearly dominating for the number of enrollments (strengthened by an additional impact of the business sector change), they are of almost an equal importance as individual performance-related characteristic of work experience for the training volume. This indicates a high level of the impact of organizational decisions in the first case and their moderation by workers' employment background in the second one. All the presented results are ensured by valid model estimates.

The first stage of the analysis provides limited evidences for a medium positive impact of the law implementation on training intensity for the workers in a direct response to the minimum wage adjustment [treatment group] and conditional negative effect with regard to the anticipatory wage adjustments [control group]. Although both inspected dependent variables show different patterns of change, they share high impact of workplace characteristics, which indicates the decisive role of the employer in the intensity of training participation on the observed labor market segment. The comprehensive conclusion is performed factoring for group-specific tendencies.

4.4.2. Predictors: Within and Between-Group Comparison. Interaction Effects

As for the two already inspected dependent variables, we employ interaction and marginal effects to characterize group heterogeneities. For the clear presentation of the results under the broadened observation period and both dependent variables measured on a metric scale, we discuss statistically significant results only. The theoretical effects that are not included in the interpreted body of findings are to be considered unimportant for training intensity on the minimum wage labor market.

As the introduced method of analysis works with the difference scores instead of actual values of the variables, estimating the systematic impact of the wage adjustment within observation periods by interaction effects is needed in terms of the joined model only. OLS models for the two measurement points perform the estimation by nature of their construction. Table 39 below proves previously indicated results. We find higher number of training events for the members of the treatment group in comparison to those of the control group in 2015-2016 observation periods, provided that other characteristics are held stable. No meaningful interaction effects are indicated for the training volume, which, as discussed, has significantly

decreased after the law implementation for the members of the control group who have not changed their listed explanatory characteristics.

Table 39. Determinants of the Change in the Training Intensity: Interaction Effects (Affection by the Minimum Wage Introduction and Equation Dummy) in the GLS Population-Averaged Model

	Number of enrollments: B(SE)	**Training volume: B(SE)**
Constant	-0.99 (0.56)	**-22.20** (8.27)**
Firm location	-1.04 (2.47)	**-185.73*** (6.27)**
Business sector	**0.92** (0.37)**	5.06 (6.27)
Company size	**-0.59** (0.22)**	**7.33** (2.92)**
Labor income	0.00 (0.00)	0.00 (0.00)
Job tenure	0.03 (0.07)	-0.15 (0.77)
Job complexity	-0.11 (0.38)	0.44 (5.18)
Contract duration	-0.29 (0.70)	5.35 (8.14)
Employment form	-0.77 (0.82)	-2.55 (10.10)
Work experience	0.08 (0.39)	**22.05*** (7.46)**
Affection by the minimum wage introduction # Equation dummy. Baseline: Control group # 2015-2016		
Control group # 2014-2015	1.30 (0.78)	-1.53 (6.40)
Treatment group # 2014-2015	0.60 (0.55)	0.10 (5.98)
Treatment group # 2015-2016	**1.66*** (0.55)**	-5.15 (6.17)

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

An additional alternative for specifying the time trends within groups is calculating predictive margins to gain an understanding of the mean values of predicted annual changes. The results are presented in the Tables 40 and 41 below. Whereas for the number of training events those are identical in the direction of change to the previously presented ones, they deliver new insights for the dynamic of training volume. In particular, we observe a statistically significant average decrease of 6 days for the members of the treatment group prior to the law implementation, which is also present in the discussed descriptive statistics. This is not the case for an increase of 5.18 in a two-year perspective of 2014-2016. We attribute the effect to the 6 indicated most influential cases, four of which represent usual increase in training volume for the treatment group and two – its major decrease for the units in the control group. Hence, the finding concerns individual cases and does not represent a tendency. This explains the absence of its impact on the reported total and average training volumes of the group.

Table 40. Change in the Number of Enrollments and Affection by the Minimum Wage Introduction: Predictive Margins

	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
Control group	0.60	-0.82	-0.23	-0.12
Treatment group	-0.48	**1.07***	0.17	**0.39****

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 41. Change in the Training Volume and Affection by the Minimum Wage Introduction: Predictive Margins

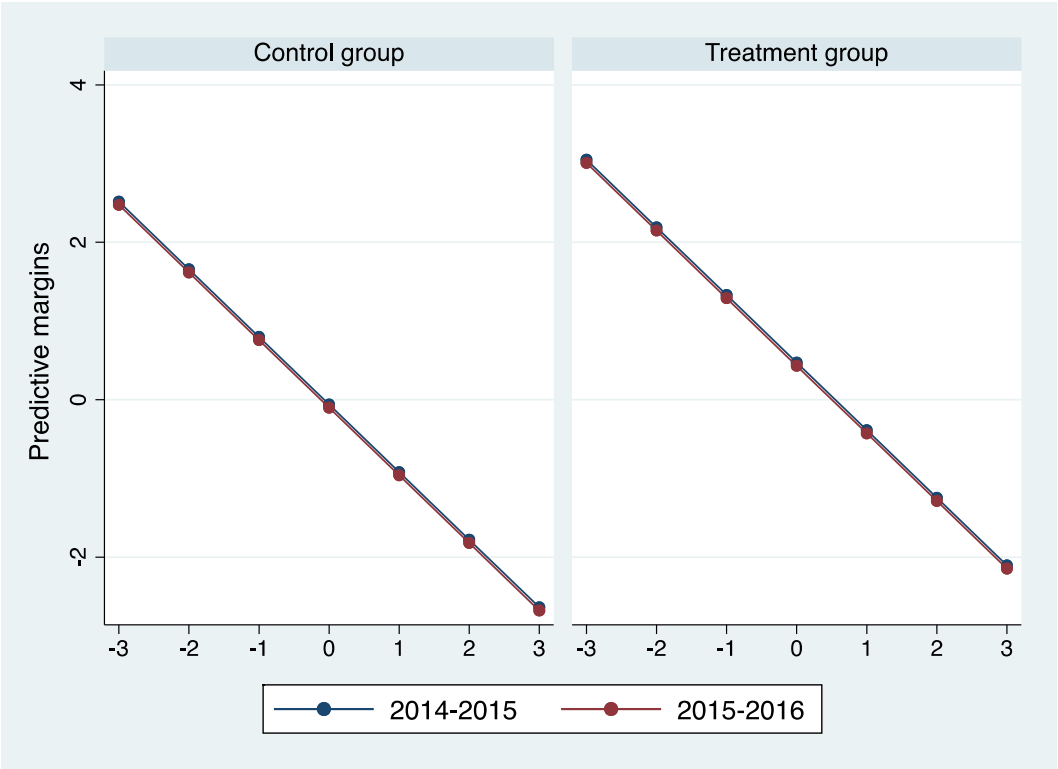
	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
Control group	-2.14	1.36	2.17	-0.78
Treatment group	**-6.00*****	0.44	**5.18*****	-2.52

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Time trends of the variables measured on ordinary scales are most clearly represented in the differentiated conditional-effects-plots. Figure 11 below proves the negative influence of the change to a larger company on the number of enrollments within both groups. The effect is also held stable within two observation periods, indicating its independence on the minimum wage introduction.

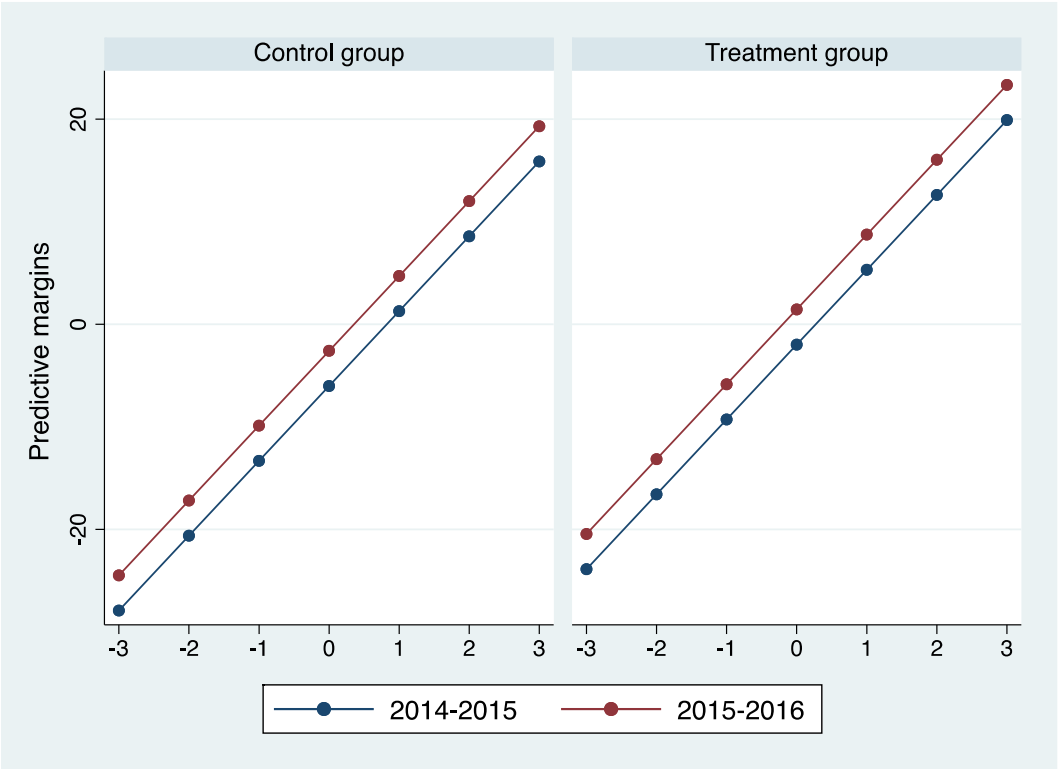
Figure 11. Change in the Number of Enrollments and Change of the Company Size under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

As noted, the predictor has an opposite effect for the training volume (shown in the Figure 12 below). It also moderately increases for both in a difference score of a second observation period. The significance of the company size variable across the four examined models allows to make a generalized interim conclusion. Despite the indicated discrepancies in the training incidence between the treatment and control groups on the basis of company size, those are absent for the training intensity. Hence, there are entry barriers for training participation with regard to the wage adjustment, combined to a simultaneous equality of opportunities in terms of the amount of human capital investments per participant. Differences within company size categories remain persistent across all the models.

Figure 12. Change in the Training Volume and Change of the Company Size under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

The baseline models of First Difference Regression show that change of the business sector does have an effect on the number of enrollments only. We find a significant interaction effect between the predictor and affection by the minimum wage introduction presented in the Table 42 below. Namely, change of the occupational sector for the person whose income was adjusted with accordance to the law implementation increases the total annual number of overtaken training events by 1.59. This provides limited evidences for following developmental strategies under company restructuring and/or recruitments. Those differ further in the magnitude with regard to the company size, as described above.

Table 42. Determinants of the Number of Enrollments: Interaction Effects (Change of the Business Sector and Affection by the Minimum Wage Introduction)

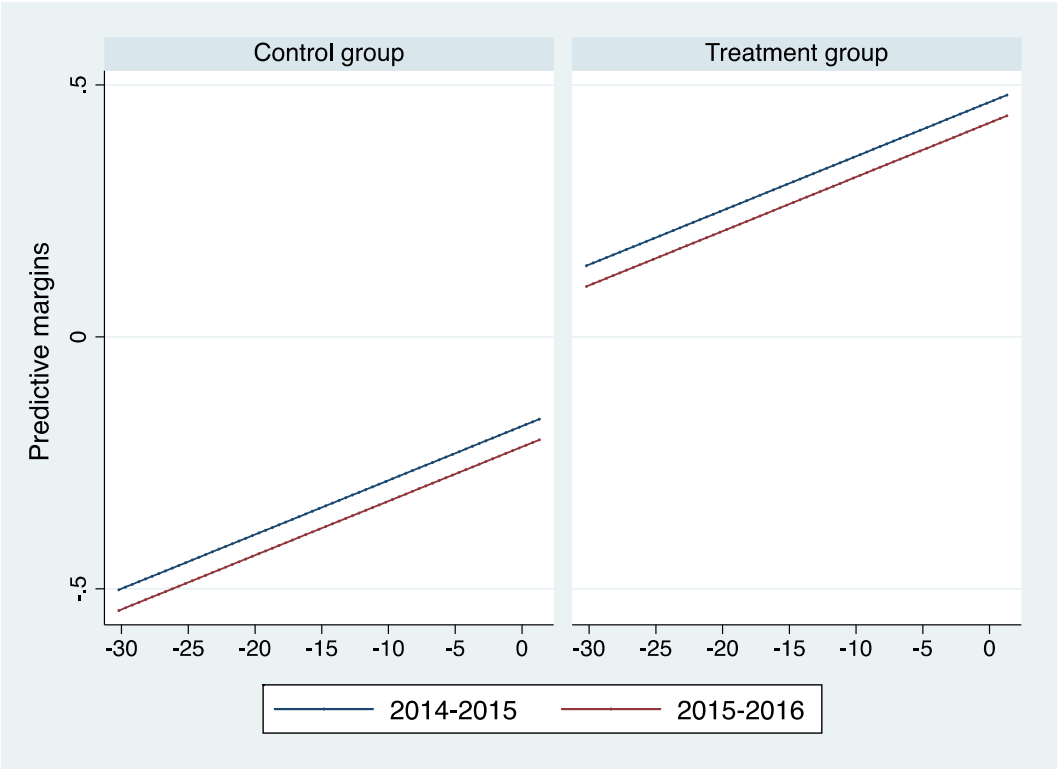
	2014-2015 OLS	2015-2016 OLS	2014-2016 OLS	Combined GLS
	B (SE)	B (SE)	B (SE)	B (SE)
Constant	-0.50 (2.27)	-0.39 (1.42)	-1.05 (1.98)	-0.27 (0.38)
Firm location	0.69 (2.21)	0.00 (0.00)	0.83 (3.00)	-1.12 (2.60)
Affection by the minimum wage introduction #	1.18 (5.34)	1.67 (1.09)	1.54 (0.98)	**1.59*** (0.34)**
Change of the business sector				
Company size	0.63 (0.42)	-0.10 (0.47)	-0.73 (0.55)	**-0.99** (0.17)**
Labor income	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Job tenure	0.15 (1.87)	0.05 (0.12)	-0.04 (0.30)	0.01 (0.06)
Job complexity	0.08 (0.53)	-0.15 (1.82)	0.13 (0.78)	0.02 (0.29)
Contract duration	0.03 (0.98)	-1.08 (1.78)	0.09 (2.77)	-0.58 (0.61)
Employment form	-1.70 (1.33)	-0.90 (1.81)	-0.83 (1.62)	-1.33 (0.67)
Work experience	0.31 (1.02)	0.20 (1.36)	0.41 (0.88)	0.24 (0.26)
N	65	65	55	130
R^2	0.08	0.07	0.10	
Equation dummy				0.13 (0.56)
Wald Chi2				**60.84*** **

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Figures 12 and 13 show the group characteristics in the effect of workplace change and worker's employment background. Despite the fact that direction of the relationship between the outcome and predictor remain the same on four graphics, a closer look with regard to the values of the predictive margins is needed for group comparison. In particular, the workers in the control group risk the most decrease in the training volume by switching the workplace of a long job tenure (sample maximum: 30 years). The fall becomes less as the job tenure of the previous employment relationship shortens. On the one hand, this is attributed to the reduced need for training due to already acquired abilities. Alternatively, job tenure of a long duration is also a sign for the worker's older age that decreases human capital investment motivation. The same pattern is observed in the treatment group with the difference in a baseline level. This implies that the workers in the treatment group who continued working by the current employer have received a minor increase in the number of days of further education. On the contrary, training volume shortens in the control group unless having stayed at the workplace for the previous year. The exact decimal values of the change in both predictors are ambiguous due to the annual differences in the interviewing dates. Law implementation negatively affects the strength of the described statistical relationships.

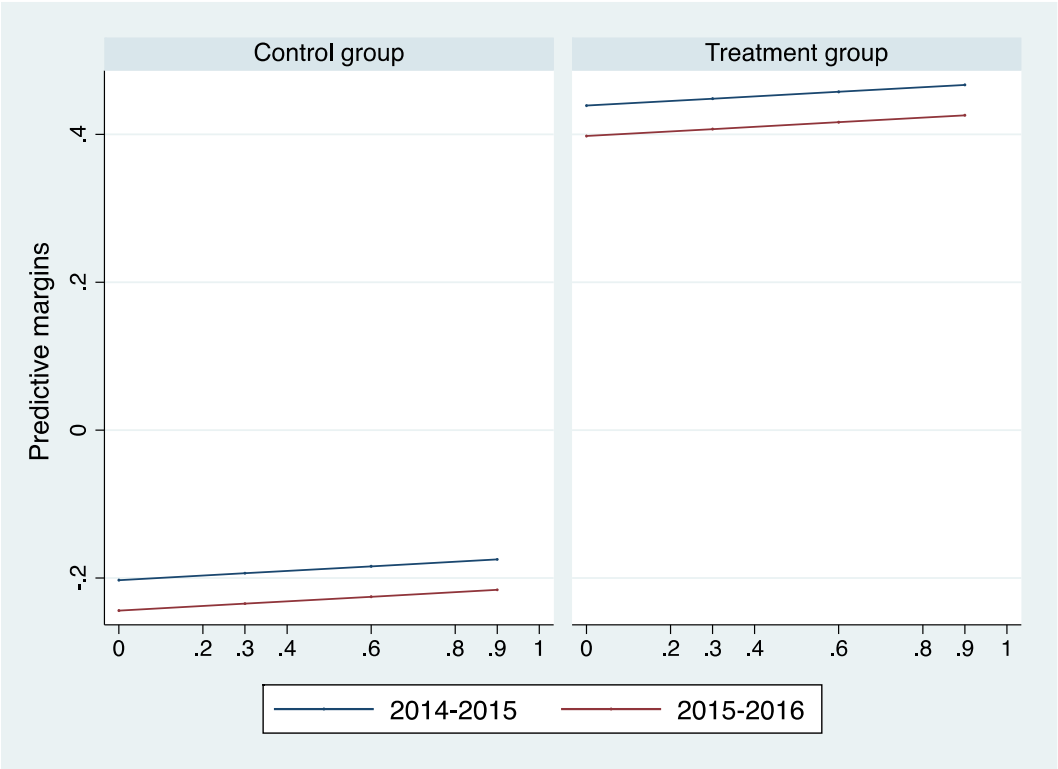
Figure 13. Change in the Training Volume and Change of the Job Tenure under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

The same pattern is indicated by the change in work experience. The discussion in the first part of the analysis has covered the positive impact of its increase on the amount of human capital investments measured as a total annual training volume. Similar to the job tenure, the effect of the regressor is more profoundly expressed in the treatment group. In this case, absolute zero point in the difference score does not have a practical application, as sample includes persons employed in both years. Values that are very close to zero refer to the job start at the end of the year prior to the data collection. Annual comparison does not support an assumption in the increase in strategic human resources activities on the work experience basis after the minimum wage implementation. Those actually decrease in comparison to the previous observation period, for which the effect has not appeared as significant in the baseline model.

Figure 14. Change in the Training Volume and Change of the Work Experience under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

Table 43 summarizes the previous findings for the number of training events. Its increase after the minimum wage adjustment in accordance to the law is independent on the change of other controlled characteristics of the employees. Nevertheless, transitions in those of a firm level are of a higher statistical strength in predicting the dependent variable. Its strongest negative relationships are observed with the difference score by the company size under the absence of group-specific and time trends. The second and last indicated time-changing predictor in the number of enrollments is the significant interaction effect of the occupational sector switch for the treatment group.

Table 43. Overall, Within- and Between-Groups Effects of Significant Predictors of Change of the Number of Enrollments under the Minimum Wage Introduction

Change in the predictor	Relationships: Baseline model	Between-group differences	Change in the strength of the relationships after the minimum wage implementation	
			Control group	Treatment group
Company size	Inverse	No	No	No
Business sector	Positive impact on dependent variable	Yes	No	No

Source: Chapters 4.4.1-4.4.2 of the paper

Table 44 does the same for the change in training volume. Prior analysis of statistical significances delivers limited evidences for its decrease for the members of the treatment group before the law implementation and for those of the control group afterwards particularly as well as in the whole observation period. These patterns are restrictedly reflected in the effect of the listed predictors. Namely positive relationship of the training volume difference score are captured with those of the work experience and job tenure. Complications for the interpretation under the group-specific values have been addressed in the respective parts of the chapter. The score of the change in the company size stands in the positive connection with the increase in training volume for both groups. Comparing the statistical strength of three predictors in a row is problematic due to the drawn limitations.

Table 44. Overall, Within- and Between-Groups Effects of Significant Predictors of Change of the Training Volume under the Minimum Wage Introduction

Change in the predictor	Relationships: Baseline model	Between-group differences	Change in the strength of the relationships after the minimum wage implementation	
			Control group	Treatment group
Work experience	Positive	Yes	Decrease	Decrease
Job tenure	Positive (See interpretation)	Yes	Decrease	Decrease
Company size	Positive	No	Increase	Increase

Source: Chapters 4.4.1-4.4.2 of the paper

The current chapter closes the analysis of the indicators of training participation and provision with regard to the minimum wage introduction. To keep the coherence in the presentation of results and make reading the paper suitable for inspecting indicators separately, we first formulate the interim conclusion for the training intensity only. The synthesis of all the drawn conclusions is performed in last part of the closing chapter.

4.3.3. Minimum Wage Introduction and Training Intensity: Interim Conclusion

The analysis of training intensity has solidly broadened our understanding of the minimum wage impact on further education of the affected workers. Usage of several metric variables, comprehensive experimental logic of the method, multidimensional interpretations exclude the possibility of a holistic answer for the stated research question. The results of this stage of analysis are also contrasting from the previous ones due to their implication for the training participants only and operation on the difference scores instead of the actual values of the variables. Reasons for these methodological decisions and their benefits have been discussed on the respective stages of the analytical procedure.

The number of enrollments show consistent results when comparing descriptive statistics and with their significance analysis. We find a moderate positive impact on the number of training events after the law implementation for the workers whose wage has been adjusted in a juridically prescribed time frame in comparison to those who have been covered by the anticipatory wage adjustments. The finding is also valid for the whole observation period either, though with the lower effect size and minor inconsistencies with the descriptive statistics due to the balanced panel construction. For the members of the treatment group, the effect of the predictor is enhanced by the occupational sector adjustments. Hence, strategies for the human resource and organizational development, production process optimization and advancement in response to the increased labor price are present with regard to broadening the learning spectrum.

In comparison to the number of further education events, training volume is more sensitive to individual-level variation instead of one of organizational-level decisions. Hence, its dynamic for the central research question is less clearly articulated. In particular, we observe limited evidences for a decrease in training volume for the directly affected workers before the law implementation and for the selected observations in the control group afterwards, when controlling for the change in other explanatory characteristics. For this reason, it is reasonable

to explain the above described developmental strategies by the cost-saving ones through shortening the duration of training events. The observed significant relationships of the latter with the work experience and job tenure variables, provides additional insights with regard to worker's employment biography and latently, age.

Special attention should be given to the dynamics of both predictors in relation to the change in the employing company size. First, it has provided an additional prove for the tendency of shortening the duration of training events when their number increases. The evidence is mediated by the specificity of work in the companies of different sizes. Second, it has opened an additional discussion field upon the equality of organizational opportunities independent of training incidence expansion. The stability of the predictor for the number of enrollments and its minor dynamics with regard to the training volume, also allow for its attribution to the overall strategies of further education participation and provision instead of the minimum wage introduction framework.

Although the law does have a significant impact on training intensity, its other predictors included in the model implicitly and controlled as unobserved unit effect are dominating it. Minimum wage does not radically change the strategies of training behavior and/or provision but corrects them for group specifics at the given time-points. Despite the differences in the dynamic of selected indicators, they remain subordinate for the patterns of the human capital theory. Formulated explanations for the observed patterns are drawn on the theoretical basis and are not free of the approached limitations. The incorporation of the three stages of findings into a common model and their comprehensive discussion are the subjects of the concluding chapter.

Chapter 5. Implication of the Research Results and Conclusion

5.1. Aggregation of the Findings

Further education fulfills the number of functions that are vital for both firms and employees. From the company's side, training demonstrates the orientation for technological innovations and organizational development. Under a major expansion of further education in the recent decade, it has become one of the essential standards of the employment quality to attract and retain qualified labor force. In return, workers are placed under the reciprocal pressure to realize own professionalization initiative, continuously acquire new skills and develop present ones through specialization. Nevertheless, this perspective is not unconditionally transferable to the minimum wage labor market. Before the law introduction, potentially affected groups have already shown lower training participation. Profound labor price increase has made its further development highly debatable. We contribute to this discussion by empirical evidences and their implications to the theory.

For the treatment assignment, we use a subjective assessment on the basis of the branch tariff adjustment which allows differentiating between employees who have received a pay raise within the juridically prescribed period and those falling under the anticipatory wage adjustments. This allows modelling the factual event of the law impact, whereas labor income is used as the measure of the affectedness magnitude. At this point, we have fulfilled the goal of separating the increase in the hourly wage due to the establishment of the minimum one from the additional payments, bonuses, compensations for the extra work, etc. We have explicitly excluded the cases of incompliance with the law to control for the effect of the actual labor price increase. Our findings advocate the fact that it is the wage adjustment point and not the absolute sum of the income that regulate human capital investments on the minimum wage labor market.

The limitation of the current sample construction is made transparent either. We do capture inconsistencies in the statistical profiles of its two parts. As the treatment and control groups do not differ in the direction of relationships the central variables other than those answering the research question, we suggest the extrapolation of our findings for predicting the training provision and participation on the minimum wage labor market. At the same time, we place a stronger emphasis on the notion of a direct affection by the law and check the robustness in between and within-groups comparisons. Members of the control group prominently show higher rate of human capital investments expansion; therefore, we cannot fully reject the assumption that the indicated discrepancies in the characteristics are potential sources, as well

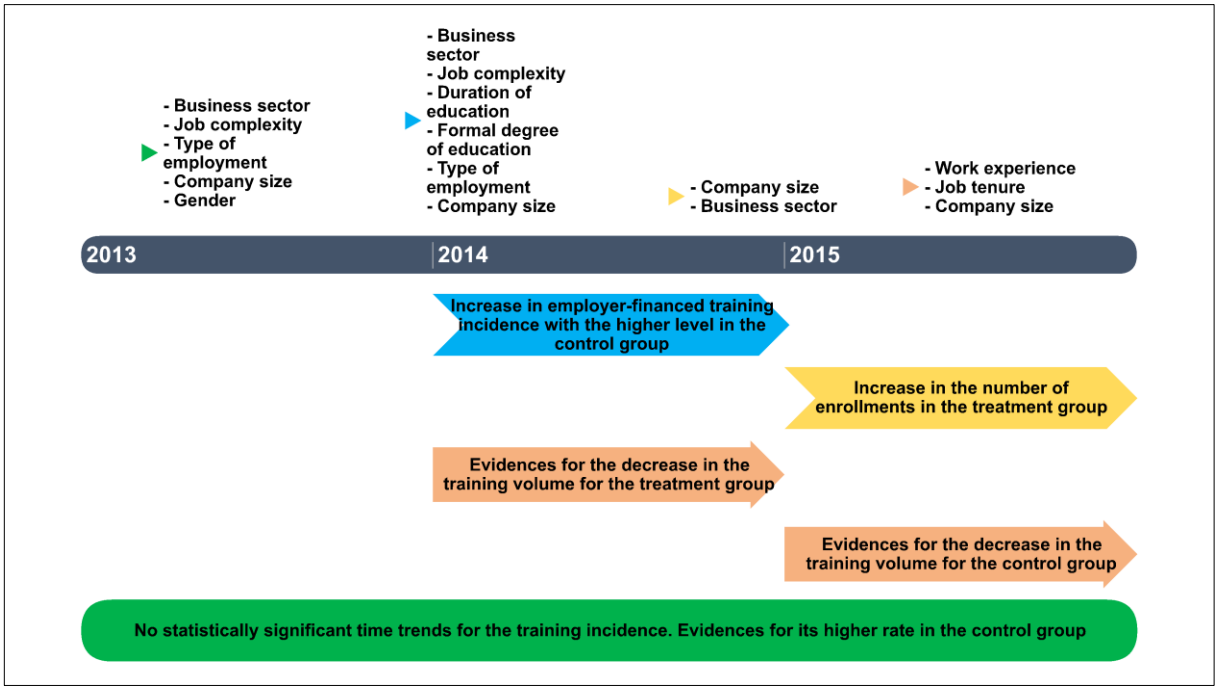
as outcomes of an earlier income raise. With this, we fulfill the central research objective presenting the evidences for the dynamics of training indicators and their predictors on the minimum wage labor market.

Illustration 3 summarizes the findings of the current paper with the focus on trends of the dependent variables. Due to the nature of the employed statistical procedures, it is possible to compare the directions of the relationships only as well as synthesize the conclusions upon their content. Each model is a product of implication of the comprehensive theoretical overview for the methodology, fitted to the nature of the research question. In order to schematically present the results, we differentiate between three notions with regard to the time trends: absence of tendencies (ellipse), meaningful absolute increase (chevron) and limited evidences for a downward adjustment (pentagon). The separation between the latter two is performed on the basis of the pattern of statistical significances. In the first case, variables show the same character of change throughout the baseline model and a robustness check; in the second one their coefficients are only episodically significant (e.g. marginal effects). The colors are introduced to mark outcomes with respective predictors. The latter are ranked with regard to the magnitude of their effect in the baseline model and will be discussed later in detail. Employing the variety of solutions for modelling the panel data comes at the cost of limitation of their cross-model comparison. The timeline represents the actual calendar years and findings fitted into it, as discussed in the Research Design (Illustration 2).

The summary of findings proves the complexity of the minimum wage introduction impact on the training participation of the affected workers. The current research shows that the concept of human capital investments is not ambiguous. The choice of the indicator is crucial for estimating the effect of the labor price increase at different stages of the law implementation. *Training incidence*, which is a general expansion measure for training participation, *does not exhibit any statistically significant time trends*. This appears plausible because of the inter-compensation between different sources of human capital investments in the period of their adjustment. To what extent each cost bearer contributes to the variation, remains an exercise for the future research to explore. We have presented a number of valid evidences for a clear domination of the firm in these terms. Moreover, *the announcement upon the law introduction induces a further increase in employer-financed training incidence*. As the latter is a sign for developmental and production optimization strategies through training provision, it appears comprehensible that they are rational for a firm to adopt prior to the labor price increase in order to cover the latter with the gained profits. Further empirical insights are needed to detect the upcoming shifts of the variable. Additionally, the underlined productivity

update is reflected in *an upward adjustment in the number of enrollments after the minimum wage implementation for the workers who have received a pay raise at this time*. This clearly reflects the precise strategy of human resources development. The variety of training measures potentially represents the spectrum for acquisition of additional skills. Due to its high organizational and financial costs, it is reasonable to perform on a group-specific selective basis. On the one hand, those are the workers who most urgently need the productivity increase, as their labor has instantly become more expensive. On the other hand, human capital investments are supposed to bring the most return when the workers already have a sufficient basis for further qualifying. The latter is predominantly one's training background, which is controlled by constructing the indicator for the participants only. Finally, the data provides evidences that the upcoming training costs are potentially passed along and absorbed by *the two indicated negative shifts in the training volume*. Despite the fact that those are cost-saving initiatives, they are minor in their influence on the overall training expansion and content variety. These are also potential signs for the discussed optimization of training participation itself through shortening the duration of courses, changing their content and composition without an effect on the training expansion. Hence, we advocate the prevalence of the "high road" strategy with regard to the law introduction. To sum it up, we conclude upon *the moderate differentiated positive effect of the minimum wage on training opportunities for the affected workers in Germany*.

Illustration 3. Minimum Wage Introduction in Germany and Training for the Affected Workers: Summary of Findings



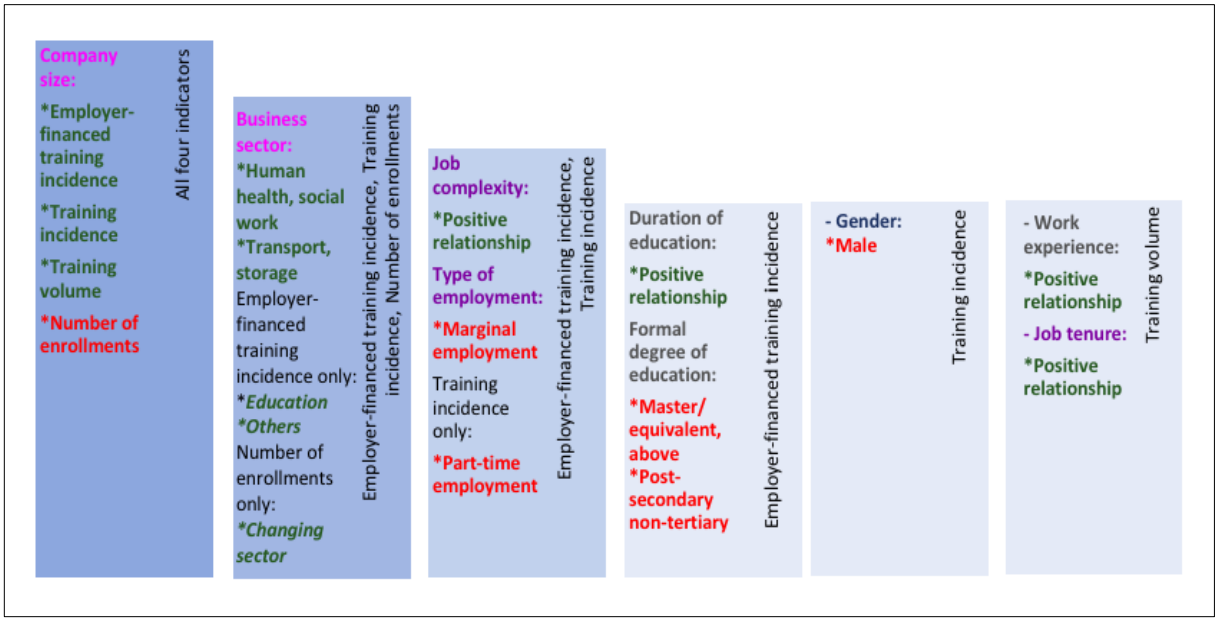
Source: Chapter 4 of the paper

Illustration 4 extends the upper part of the previous scheme with regard to the direction and magnitude of the influence of predictors. The magnitude is constructed as a measure of frequency of statistical significance of the regressor across all models. Four groups of independent variables are derived with regard to the number of predicted outcomes (listed in black) and marked with descending blocks. The predictors are further classified according to the type of characteristics: firm-level (pink), individual work-related (purple), individual performance-related (grey) and personal (blue). We also differentiate between positive (marked with green) and negative (marked with red) impacts on the dependent variable(s).

Characteristics that are related to the workplace solidly contribute to establishing discrepancies in human capital investments for all the cost bearers. It is worth noticing that both dominating firm-level variables show the same implication when differentiating between overall training incidence and one provided by an employer. This confirms the primary assumption of the human capital theory for the incorporation of different sources for investments towards the unified standards of credibility. Therefore, the influence of labor force characteristics and further education context is reciprocal. Compliance with the human capital theory is preserved by the workplace characteristics on the individual level as well. Those go

in line with the affection of different positions by the minimum wage introduction and imply reproduction of training provision inequalities within the current observation period. The assumptions of the signal theory are hold valid either, due to the significance of education for the employer's training cost coverage only. Screening the most abler persons on the basis of formal certificates basis constitutes a clear feature of a firm investment decision in comparison to other training cost bearers. The impact of the job tenure and work experience characteristics is not by default integrated in this argument, as its significance is predominantly driven by an emerging workplace transition and not the complete employment background of the worker. Instead, training incidence shows sensitivity towards personal characteristics, namely gender. It is reflected in the baseline model as well as in comparative focus on the employment type and business sectors. The latter is a product of the branch-specific labor force compositions, whereas others potentially reflect differences in perceiving minimum wage and/or part-time employment in a gender perspective. Focused qualitative research would become the most appropriate methodological solution with this regard. Notably, the influence of other personal characteristics is virtually zero. We believe that this is a result of a homogenous socio-demographic structure of the studied employees' segment, in comparison to others, absorbing the whole body of predicted disadvantages.

Illustration 4. Predictors of Human Capital Investments under the Minimum Wage Introduction: Summary of Findings

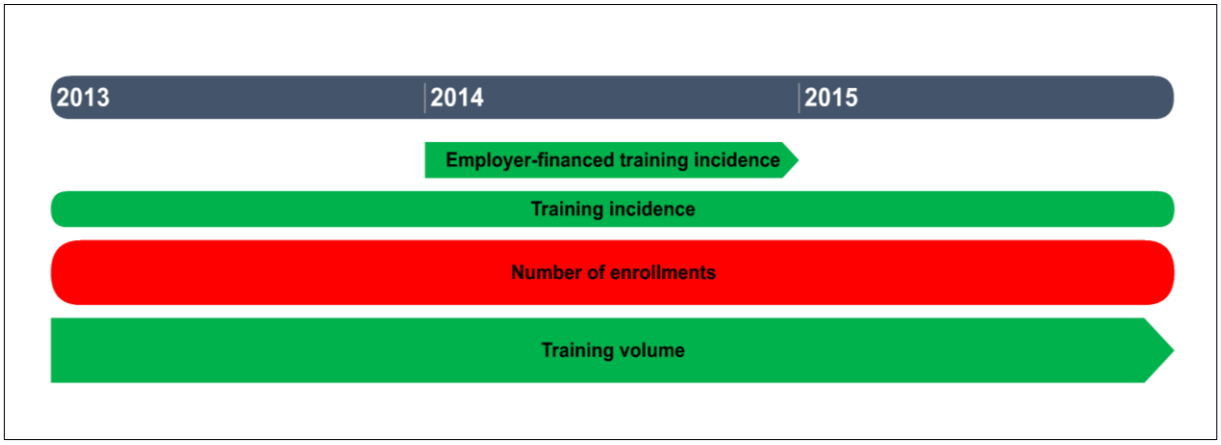


Source: Chapter 4 of the paper

The results of the current analysis entitle *company size as the most important predictor of the human capital investments on the minimum wage labor market*, as it is highly significant for all the four inspected indicators. This is plausible with regard to a high importance of the variable for defining the distribution of the minimum wage impact, firm economic behavior and characteristics of the employed labor force. Illustration 5 deepens the understanding of the relationships of different measures of training and company size. We use following attributes for meaningful connections. Positive impact on the outcome is marked with green and negative one with red. The increase of the influence is marked with a pentagon and its stability with an ellipse. Between-group inequalities are demonstrated in the thick blocks by their absence and thin ones when they are present.

In particular, we find a dominating positive relationship between the company size and the incidence and amount of human capital investments, except for the number of enrollments. The latter is relevant with regard to the functional specificity and labor division strategies in the companies of different scope, discussed in detail for respective variables. The presence of strengthening the relationship between the predictor and the outcome as an alternative to the absence of a meaningful time trend is a sufficient basis to conclude upon a moderate positive effect of the minimum wage introduction with regard to the company size. On the one hand, we do observe an increase of employer-financed training incidence and training volume for the companies of all sizes, but it goes in line with an established framework of inequalities that does not exhibit major development. The latter is driven by the stability of training incidence indicator with regard to the central research question. At the same time, the amount of human capital investments has the most potential for diminishing between-group inequalities of training provision. Although the companies still exhibit major selectivity with regard to the further education expansion, participants are treated equally both in the number and duration of training events. The most comprehensive conclusion with this regard could be made comparing all groups of workers.

Illustration 5. Company Size and Training under the Minimum Wage Introduction in Germany*:* Summary of Findings



Source: Chapter 4 of the paper

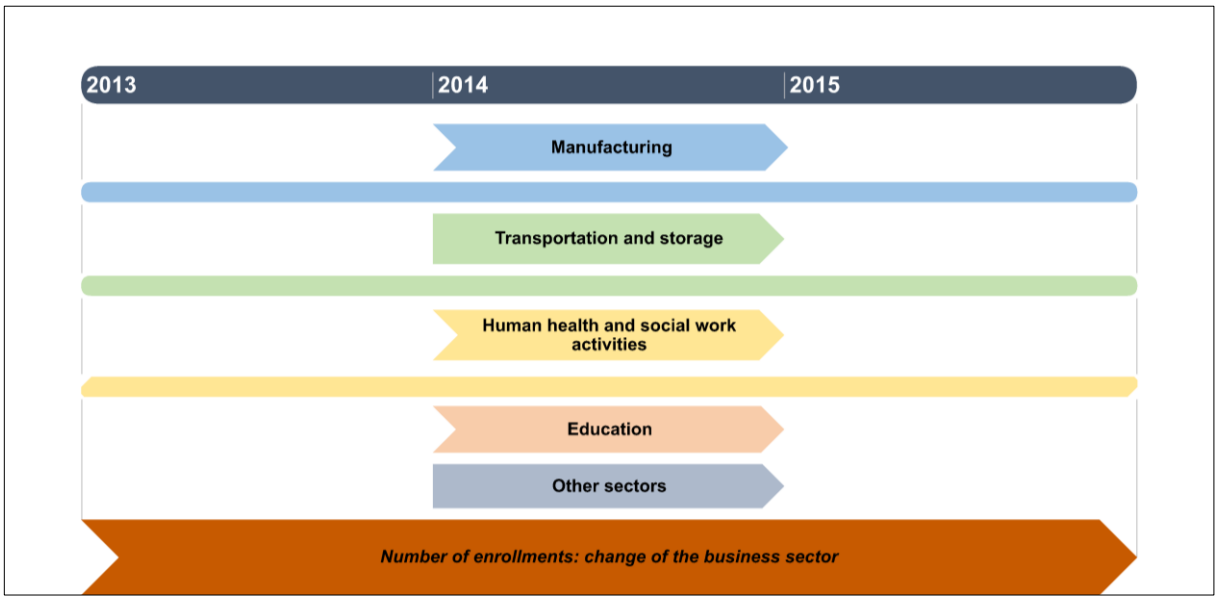
Business sector is significant by the three of four presented indicators and with this *is the second most important predictor of human capital investments on the minimum wage labor market*. It is both a basis for the wage adjustment and training provision policies, technological standards and developments, characteristics and requirements of the workforce. Illustration 6 summarizes graphically the findings upon the training participation and its development in the largest sectors of the minimum wage labor market, where further education is highly widespread. Similar to the previous scheme, we separate several types of logical relations: a meaningful increase of the employer-financed training incidence under the preservation of between-group inequalities (chevron), a meaningful increase of the employer-financed training incidence without between-group differences (arrow right), an overall high level of training incidence without between-group differences (ellipse), an overall high level of training incidence under the preservation of between-group inequalities (slanted edges) and a meaningful increase in the number of enrollments in the experimental participants' group (thick chevron). The current state of research characterizes Manufacturing as a suitable representation of a highly developed branch with the high level of training participation, therefore, it serves as the baseline category.

It is important to combine the findings upon different indicators to gain an understanding of how the training incidence level within the branch influences employers' human capital investment decisions. In particular, a higher level of employer-financed training provision in the Transportation and storage and Human health and social work activities branches is not a product of employers' developmental strategies on their own [as it is the case in the sectors

below] but takes place in response to the high sectoral further education standards. No straightforward theoretical interpretation is derived on the basis of between-group inequalities, as three sectors, for which both indicators are available, show different combinations of these relationships. In particular, in the Human health and social work activities sector, higher levels of both training incidence and employer-financed one are observed for the control group. This is potentially attributed to the strict hierarchical structure of tasks and gains in the branch that discourage employee's training initiatives. In Manufacturing, the tasks are also hierarchically distributed, but promotion does not require completing an additional formal degree, as it is often the case in the Human health and social work activities sector. Therefore, between-group differences in the training incidence are absent. The Transportation and storage branch does not exhibit group-specific differences with regard to both terms. For the two lower sectors, variation upon the employer-financed training incidence is significant only. It is reasonable to relate the group inequalities of training provision in the Education branch to those described for the Human health and social work activities. In the "Other sectors" category, they are absent as it does not demonstrate a particular institutional framework but is a cumulative representation of those branches less affected by the minimum wage introduction. Remarkably, an increase in the number of enrollments for the treatment group under the sectoral change takes place independently of the branch.

Our findings imply that the primary further education standards in the business sectors dominate the impact of the minimum wage introduction. We find limited evidences for an increase in employer-provided training incidence in the sectors of a higher technological development and knowledge intense work and/or those providing public services. As there is no statistically significant negative impact for the sectors with the highest shares of workers affected by the law, the presented baseline explanations are more comprehensible for explaining higher rates of training participation in these branches in comparison to the lower impact of the law for them. Transportation and storage sector partially falls under a twofold interpretation with this regard. On the one hand, it does include Taxis that are one of the major target groups of the legislation. On the other hand, their share within the whole branch is too low to be able to establish a meaningful positive effect of the minimum wage introduction on training opportunities for these workers. Taking into account the whole bench of findings, we define a business sector as an important institutional framework for training participation on the minimum wage labor market and not its emerging predictor with regard to the law implementation.

Illustration 6. Business Sector and Training under the Minimum Wage Introduction in Germany: Summary of Findings



Source: Chapter 4 of the paper

Our findings imply the differentiated impact of the minimum wage introduction on various indicators of human capital investments and, with this, prove the necessity of parallel trends' comparison for several of them to achieve comprehensive modelling of casual relationships. The impacts of predictors remain plausible in their relations to the minimum wage introduction. Nevertheless, their magnitude goes in line with the predominating theoretical framework and episodically enhances it. Therefore, training dynamics on the minimum wage labor market is beneficial to study in its terms. The short time period after the law introduction, prevalence of other labor price-related issues, prioritization of other groups of workers in further education provision shape the impact of the minimum wage introduction towards reproducing previously established inequalities. The episodically observed increases in the dependent variables and cases of absence of the between-group inequalities form a basis for positive predictions with regard to the human capital development in the observed labor market. Its indicated peculiarities with regard to other segments are reflected in the several challenges towards patterns of the baseline theory. Table 45 summarizes the formal hypothesis check.

Table 45. Minimum Wage Introduction in Germany and Training for the Affected Workers: Hypothesis Check (Summary)

Hypothesis	Result
Introduction of the legal minimum wage reproduces and deepens existing inequalities in training incidence and intensity of the affected workers.	Confirmed
On the contextual level, lower training participation is observed in the most affected sectors (Retail, Accommodation and food service activities, Transportation) and in small companies. Its higher rate is attributed to the East German establishments in comparison to the West ones.	Partially confirmed
In terms of the job-related characteristics, higher job complexity, permanent and/or full-time contracts have positive impact on training provision, whereas the relation of the latter two to labor income and job tenure is reverse.	Partially confirmed
For performance-related characteristics, education and training remain complements. The connection of the latter to work experience is opposite.	Partially confirmed
Personal characteristics affect training participation in the following way: younger age, male gender and absence of migration background increase the training chances of an employee.	Rejected

Source: Chapters 2 and 5.1 of the paper

The current analysis makes clear that the patterns of training provision and participation under the minimum wage introduction go beyond the simplicity of straightforward theoretical links. Most of the hypothesis are confirmed only partially and are of a little scientific value without a detailed explanation. Before closing conclusions, we present a critical evaluation of the study in the next chapter.

5.2. Evaluation of the Study

As the current paper seeks to make representative conclusions on the country basis, it is important to make the shortcomings in the extrapolation of the findings transparent. As for any quantitative research, we have met numerous methodological choices that have established the limitations of the gained knowledge. The driving motivation behind is the clear fulfillment of the drawn research objectives, straightforward answer to its central question and conclusions. We do admit a share of arbitrariness in the current analytical procedure which is unavoidable in experiments and their quantitative evaluation under the absence of unified standards. Therefore, at these points alternative methodological solutions could be reasonable either. At

the same time, we advocate our research design as the most reasonable implication for the formulated problematics in the described scientific context.

The paper starts with a comprehensive theoretical framework and revision of the main meaningful links and their predictors. We seek to establish the interdisciplinary approach that comes at the cost of reducing the complexity of single concepts. As we place our study in the framework of labor economic approach and human capital theory, our focus is limited by the level, dynamics and predictors of the dependent variables. Therefore, we suggest future research on the basis of further education panels capturing a greater variety of outcome indicators to detect the impact of the minimum wage introduction on different types of training depending on skills, organizational degree and form; their reference to the demand for different skills' groups; cost shares in their financing. The current paper is not claimed to estimate comprehensively the outcome of the minimum wage but focuses on its further education impact. Therefore, we believe in the vital necessity to cover further changing aspects in the employment quality, workplace characteristics, subjective gains of both workers and employers after the law introduction.

We overtake the order of evaluation criteria in the next two paragraphs from the nominated meta-analysis in the field of further education research (Glaub and Frese 2011) and make generalized conclusions with the bench of applied methodological literature. Our analysis is carried on using the sample of a high quality. Its size meets the predominant statistical requirements and the procedure of construction makes it representative for the population of the targeted individuals. The usage of the multi-themes survey minimized the selection bias that is still unavoidable in the balanced panel construction. The framework of the research design follows the policy evaluation procedure and implies a quasi-experimental logic. We use the control group to control for extraneous variables influencing the outcome and joined models for baseline conclusions within the whole labor market segment. Due to the nature of the research question and survey instrument, a complete randomization in the control and treatment group assignment is impossible. Therefore, we pay special attention to the dual interpretation of their socio-demographic differences. Further development of the research topic with regard to the target population would potentially include a single minimum wage sample construction to enable multilevel modelling. We do use the pre and post-intervention measurements to detect the development of variables over time. Though the current conclusions remain descriptive and short-term, whereas longer observation period will allow to treat the time trends comprehensively in the future. The usage of the secondary data of the German Socio-Economic Panel ensures the validity, reliability and objectivity of the measurements.

The methodological application corresponds to the drawn research needs maximizing the benefits of the longitudinal dataset. The main body of findings are derived from the analysis for significance testing. We deliver a comprehensive analytical solution through the combination and inter-compensation of procedures. Descriptive statistics are employed for introductory and background information. We further check the robustness through the variety of postestimation procedures. Alternative explanations of the results are achieved using multivariate techniques instead of less consecutive methods. Nevertheless, they are limited by the available range of explanatory variables and their given levels of measurement. A qualitative research is preferable for a deeper understanding of the outlined meaningful relationships and extending their argumentations.

To sum it up, we encourage to perceive the results of the current analysis as the starting point of the minimum wage and training research in Germany and not as a final argument in its discussion. We have provided the maximum available range of evidences and their respective explanations that are possible to draw within the current state of issue. As for any another intervention or reform, the outcomes of the legal minimum wage might have a dynamic nature and several waves of adjustments. At this point, our findings comply with those of the competent researchers in the field, which is a further solid prove of their quality. Constant monitoring in the prolonged observation period, inclusion of additional indicators for the causes and outcomes, mixed-methods approach are the prominent directions for answering the open questions and extending the current findings.

5.3. Conclusion

The questions stated in the longitudinal nature refer to the bench of knowledge to be constantly developed. In the variety of currently available data, the answers become furthermore complicated and, therefore, even more valuable. Nevertheless, the major goal of science is to gain them at the single time points for falsification and verification. Both minimum wage and further education research fields are no exceptions in these terms. Within both topics, a great variety of nominated panel studies, administrative data, recently gaining popularity Big Data are assessible to the scholars to monitor comprehensively upcoming events, gain new insights on the past ones and establish casual relationships between both. Qualitative studies are no less beneficial for broadening single perspectives and selected issues. Our research ambition has been to deliver the interdisciplinary importance, complexity of interrelation and internal variety of the approached fields. Providing an emerging answer to a widely discussed

contemporary problematics, we hope to encourage alternative methodological solutions and future related studies.

We have made clear that the minimum wage introduction in Germany does follow a "quality enhancing high road" strategy. Nevertheless, it comes at the costs of other adjustment channels, as well as preserves previously established inequalities. For the latter, we have shown a differentiated picture under the focus on various firm- and individual-level indicators. The valid evidences for the complexity of training provision policies and participants' further education behavior have been discussed with regard to the impact of the minimum wage introduction on various indicators. The predominant theoretical framework does provide the guidelines for the meaningful relationships but is not sufficient for explaining all of them in the employment relationships of the minimum wage labor market. We have aimed to draw the attention to the necessity of the separated approach towards its studying.

Lifelong learning is one of the most powerful instruments to compensate for the chance inequalities of the initial education. It is an important component of the firm economic growth and individual professional development. It is an indicator of employment quality and an element of socialization. On the national level, it is one of the decisive characteristics of the country's labor force and its competitiveness. Nevertheless, coverage of the training costs often remains a point of conflict. It is furthermore common case for the low-paid low-skilled workers, who are in its most need. The topic is up to date in Germany, where the standards of employment relationships have already gone beyond the availability of basic competencies for performing the tasks and financial labor compensation. In its societal value, this research contributes to discussing on-the-job training as the potential solution for this inequality of outcomes. It is a solution that meets the interests of all the affected actors, is oriented for innovation and contributes to the common welfare.

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Appendix

Table 46. Measurement of Dependent and Independent Variables

Concept	Original SOEP long variable	Variable (new)	Values (new)	Incorporation into analysis
Dependent Variables				
Training incidence	PLG0269	*genpart:* Person participated in training in a given year, at any cost	1-Yes 0-No	Dummy
Employer-financed training incidence	PLG0275 PLG0286	*emppay:* One most important training measure paid by employer	1-Yes 0-No	Dummy
Training intensity: number of enrollments	PLG0270	*trameas:* Total number of training measures overtaken	Metric variable	Metric
Training intensity: training volume (total duration of events in days)	PLG0271	*traday:* Total number of days which the training measures took place	Metric variable	Metric
Independent variables: Firm level				
Firm location	PLJ0116	*jobloc:* Location of the job	1-West Germany 0-East Germany, incl. Berlin	Dummy

Business sector	PGNACE	*sector: 2* Digit NACE industry, sector	0-Manufacturing 1-Wholesale and retail trade, repair of motor vehicles and motorcycles 2-Accommodation and food service activities 3-Transportation and storage 4-Administrative and support service activities 5-Education 6-Human health and social work activities 7-Other sectors	Categories' dummies Reference category: 0-Manufacturing
Company size	PGALLBE	*comp_size:* Core category size of the company	1 - LT 20 2 - GE 20 LT 200 3 - GE 200 LT 2000 4 - GE 2000	Categories' dummies Reference category: 1-LT 20
Independent variables: Individual level (Job-related)				
Affection by the minimum wage introduction	PLC0508 PLC0509 PLC0510 PLC0511 PLC0512	*affect:* Affection by the law introduction	0-Control group (8.50 in 2014 and in 2015) 1-Treatment group (no minimum wage or less than 8.50 in 2014 and 8.50 and above in 2015)	Dummy

Labor income	PGLABGRO	*labor_inc:* Current gross labor income in Euro	Generic metric variable	Metric
Job tenure	PGERWZEIT	*empdur:* Length of time with firm	Generic metric variable	Metric
Job complexity: training required for the position	PGAUSB	*requ_tra:* Required training for job	1-No training required 2-Introduction to the job 3-On-the-job training or courses 4-Vocational training 5-University degree or college	Categories' dummies Reference category: 1- No training required
Contract duration	PLB0037	*type_cont:*Duration of work contract	0-Temporary job 1-Permanent job	Dummy
Employment form	PGEMPLST	*emptype:* Type of employment	1-Full-time employment 2-Part-time employment 3-Marginal employment	Categories' dummies Reference category: 1-Full-time employment

Independent variables: Individual level (Performance-related)				
Education as a formal (highest) degree	PGISCED 11	*edulevel:* ISCED-2011-classification	0-Lower secondary education and below 1-Upper secondary education 2-Post-secondary non-tertiary education 3-Short-cycle tertiary education 4-Bachelors or equivalent level 5-Masters or equivalent level and above	Categories' dummies Reference category: 0-Lower secondary education and below
Education as duration of studies	PGBILZEIT	*edu_ye:* Amount of education or training in years	Generic metric variable	Metric
Work experience	PGEXPFT PGEXPPT	*work_exp_total:* total working experience	Generic metric variable	Metric
Independent variables: Individual level (Personal)				
Age	D11101	*age:* Age of individual	Generic metric variable	Metric
Gender	SEX	*sex:* Gender of individual	0-Female 1-Male	Dummy

Migration background	MIGBACK	*migback:* Migration background	1-No migration background 2-Direct migration background 3-Indirect migration background	Categories' dummies Reference category: 1-No migration background
Survey year				
Year dummy	SYEAR	*SYEAR:* Survey year	2014, 2015 and 2016	Categories' dummies Reference category: 2014

Source: SOEP Data 2014-2016, own recoding

Table 47. Descriptive Statistics for Nominal Dependent Variables

Concept	Survey year	All (%)		Control group (%)		Treatment group (%)	
		Yes	No	Yes	No	Yes	No
All observations							
Training participation	2014	23.41	78.59	29.30	70.70	20.75	79.25
	2015	19.94	80.06	27.89	72.11	16.52	83.48
	2016	22.91	77.09	30.41	69.59	19.77	80.23
Training paid by the employer	2014	15.08	84.92	21.02	78.98	12.39	87.61
	2015	16.93	83.07	24.74	75.26	13.57	86.43
Training paid from other sources	2014	8.33	91.67	8.28	91.72	8.36	91.64
	2015	3.01	96.99	3.16	96.84	2.94	97.06
Participants ("No" answer indicates that training has been paid from other sources than employer)							
Training paid by the employer	2014	64.41	35.59	71.74	28.26	59.72	40.28
	2015	84.92	15.08	88.68	11.32	82.19	17.81

Source: SOEP Data 2014-2016, own calculations

Table 48. Descriptive Statistics for Metric Dependent Variables

Concept	Survey year	All (%)		Control group (%)		Treatment group (%)	
		Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
All observations							
Number of enrollments	2014	0.59	1.42	0.75	1.48	0.51	1.38
	2015	0.48	1.33	0.76	1.76	0.36	1.07
	2016	0.57	1.37	0.72	1.32	0.51	1.39
	All	0.54	1.37	0.75	1.55	0.45	1.28
Training volume	2014	3.37	18.38	3.08	16.52	3.50	19.19
	2015	2.66	14.23	4.40	20.44	1.92	10.42
	2016	2.41	13.02	3.22	15.82	2.07	11.67
	All	2.80	15.30	3.63	17.91	2.45	14.01
Participants							
Number of enrollments	2014	2.53	1.93	2.59	1.67	2.49	2.10
	2015	2.41	2.05	2.74	2.40	2.18	1.73
	2016	2.49	1.87	2.38	1.34	2.56	2.15
	All	2.47	1.95	2.58	1.88	2.40	2.00
Training volume	2014	14.47	36.01	10.61	29.51	16.93	39.61
	2015	13.37	29.63	15.77	36.56	11.62	23.48
	2016	10.51	25.68	10.6	27.49	10.46	24.65
	All	12.81	30.71	12.51	31.61	13.02	30.16

Source: SOEP Data 2014-2016, own calculations

Table 49. Descriptive Statistics for Nominal and Ordinal Independent Variables: Frequencies

Concept	Value (short)	All (%)			Control group (%)			Treatment group (%)		
		2014	2015	2016	2014	2015	2016	2014	2015	2016
Firm location	East Germany, incl. Berlin	29.84	28.68	29.80	15.82	16.32	16.00	36.21	34.01	35.56
	West Germany	70.16	71.32	70.20	84.18	83.68	84.00	63.79	65.99	64.44
Business sector	Manufacturing	19.67	20.32	18.62	21.43	21.74	20.00	18.84	19.67	18.05
	Wholesale, retail, repair	17.60	16.93	18.22	12.99	11.59	12.41	19.76	19.34	20.63
	Accommodation and food	6.42	6.09	7.29	7.14	5.07	8.28	6.08	6.56	6.88
	Transportation, storage	7.45	7.45	8.70	9.09	9.42	6.90	6.69	6.56	9.46
	Administration, support	10.14	9.71	10.32	3.90	2.90	3.45	13.07	12.79	13.18
	Education	5.80	5.64	4.25	5.19	5.07	4.83	6.08	5.90	4.01
	Health, social work	13.87	14.45	13.97	16.88	18.84	15.17	12.46	12.46	13.47
	Other sectors	19.05	19.41	18.62	23.38	25.36	28.97	17.02	16.72	14.33
Company size	LT 20	19.84	20.77	19.84	17.72	18.42	16.22	20.81	21.79	21.37
	GE 20 LT 200	30.75	29.23	27.05	27.85	25.79	23.30	32.08	30.73	29.06
	GE 200 LT 2000	25.60	25.72	26.65	29.11	25.79	27.70	23.99	25.69	26.21
	GE 2000	23.81	24.28	26.45	25.32	30.00	33.78	23.12	21.79	23.36
Contract duration	Temporary job	18.38	19.49	16.14	13.92	17.46	11.49	20.40	20.36	18.08
	Permanent job	81.62	80.51	83.86	86.08	82.54	88.51	79.60	79.64	81.92
Employ-ment form	Full-time employment	53.53	53.32	58.17	66.67	64.74	67.57	47.58	48.42	54.24
	Part-time employment	28.82	29.11	28.69	23.90	26.84	25.00	31.05	30.09	30.23
	Marginal employment	17.65	17.56	13.15	9.43	8.42	7.43	21.37	21.49	15.54
Education level	Lower second. and below	15.08	15.30	13.33	16.67	15.22	14.69	14.37	15.33	12.78
	Upper secondary	57.54	55.88	57.78	49.36	47.83	46.85	61.21	59.27	62.22
	Post-second. non-tertiary	7.74	8.37	8.69	8.97	10.33	11.19	7.18	7.55	7.67
	Short-cycle tertiary	2.98	2.90	5.66	2.56	3.26	9.79	3.16	2.75	3.98
	Bachelors / equivalent	13.10	14.17	10.91	17.95	19.02	13.99	10.92	12.13	9.66
	Masters/equivalent, above	3.57	3.38	3.64	4.49	4.35	3.50	3.16	2.97	3.69
Gender	Female	58.13	56.65	56.16	53.01	52.63	50.00	60.50	58.37	58.73
	Male	41.87	43.35	43.84	46.99	47.37	50.00	39.50	41.63	41.72
Migration back-ground	No migration background	69.79	66.24	72.41	66.27	65.26	70.00	71.43	66.67	73.41
	Direct migration background	19.12	22.03	19.77	23.49	24.21	24.00	17.09	21.09	18.01
	Indirect migration background	11.09	11.73	7.83	10.24	10.53	6.00	11.48	12.24	8.59

Source: SOEP Data 2014-2016, own calculations

Table 50. Statistical Significance of Group Differences in the Variation of Nominal and Ordinal Independent Variables: Chi-Square Test

Concept	Chi2		
	2014	2015	2016
Firm location	21.57***	20.33***	19.35***
Business sector	16.63*	20.98**	26.61***
Company size	2.49	5.50	7.51
Contract duration	3.04	0.71	3.35
Employment form	18.22***	20.05***	9.36**
Education level	8.18	9.41	13.71**
Gender	2.61	1.78	3.28
Migration background	3.02	0.96	3.00

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 51. Descriptive Statistics for Metric Independent Variables: Frequencies (Recoded)

Concept	Value (short)	All (%)			Control group (%)			Treatment group (%)		
		2014	2015	2016	2014	2015	2016	2014	2015	2016
Labor income	Less than 1000 Euro	33.99	32.59	27.47	18.35	19.47	17.57	41.09	38.24	31.64
	1000 - 1500 Euro	18.38	21.52	20.32	15.82	17.89	13.51	19.54	23.08	23.16
	1501 - 3000 Euro	31.62	30.54	34.46	41.77	38.95	41.22	27.01	26.92	31.64
	More than 3000 Euro	16.01	15.35	17.73	24.05	23.68	27.70	12.36	11.76	13.56
Job tenure	Less than 6 months	9.29	10.28	6.77	10.13	8.42	4.05	8.91	11.09	7.91
	6 months to < 1 year	6.13	5.22	10.76	3.80	6.32	2.70	7.18	4.75	4.52
	1 year to < 3 years	20.36	21.84	19.32	18.35	17.89	17.57	21.26	23.53	20.62
	3 years to < 5 years	13.04	13.92	14.54	6.33	10.00	14.19	16.09	15.61	14.69
	5 years to < 10 years	15.22	15.35	85	15.82	14.21	13.51	14.94	15.84	18.36
	More than 10 years	35.97	33.39	193	45.57	43.16	47.97	31.61	29.19	34.46
Job comple-xity	No training	0.21	20.10	12.63	0.65	15.43	10.88	0.00	22.10	13.35
	Job introduction	28.01	15.95	16.63	20.92	10.64	12.24	31.31	18.22	18.47
	On-the-job training	13.07	6.54	9.82	11.76	4.79	6.80	13.68	7.29	11.08
	Vocational training	47.93	46.89	49.10	52.94	54.26	55.10	45.59	43.74	46.59
	University or college	10.79	10.53	11.82	13.73	14.89	14.97	9.42	8.66	10.51
Duration of educa-tion	7 to 9 years	10.98	11.33	10.47	12.42	11.60	11.97	10.32	11.21	9.86
	10 to <13 years	65.85	65.02	66.74	62.75	62.98	64.79	67.26	65.89	67.54
	13 to ≤ 17 years	19.51	19.54	18.48	20.26	20.99	19.01	19.17	18.93	18.26
	18 years	3.66	4.11	4.31	4.58	4.42	4.23	3.24	3.97	4.35

Work experien-ce	Less than 5 years	13.08	14.88	11.67	9.09	11.64	6.80	14.87	16.28	13.71
	5 to < 10 years	12.68	13.92	11.27	11.69	12.70	10.88	13.12	14.45	11.43
	10 to < 20 years	28.37	27.68	27.16	27.27	23.81	22.45	28.86	29.36	29.14
	20 to < 30 years	26.16	23.52	24.35	35.71	33.33	37.41	21.87	19.27	18.86
	More than 30 years	19.72	20.00	25.55	16.23	18.52	22.45	21.28	20.64	26.86
Age	17 - 24 years	7.65	7.28	6.46	9.04	7.89	6.67	7.00	7.01	6.37
	25 - 34 years	14.72	16.14	13.70	11.45	12.63	8.67	16.25	17.65	15.79
	35 - 44 years	28.68	25.79	24.66	29.52	25.26	25.33	28.29	26.02	24.38
	45 - 54 years	29.45	31.80	33.27	36.14	40.53	44.00	26.33	28.05	28.81
	55 - 64 years	17.40	16.14	18.59	13.86	13.16	14.67	19.05	17.42	20.22
	Older than 65 years	2.10	2.85	3.33	0.00	0.53	0.67	3.08	3.85	4.43

Source: SOEP Data 2014-2016, own calculations

Table 52. Descriptive Statistics for Metric Independent Variables: Mean and Standard Deviation

Concept	Survey year	All		Control group		Treatment group	
		Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Labor income	2014	1749.79	1351.11	2240.97	1402.29	1526.79	1267.78
	2015	1756.27	1477.80	2227.04	1452.71	1553.91	1443.54
	2016	1942.31	1420.32	2436.10	1574.11	1735.87	1298.56
	All	1811.22	1429.89	2293.86	1474.44	1601.96	1349.4
Job tenure	2014	9.23	9.43	10.80	10.02	8.52	9.08
	2015	8.80	9.32	10.89	10.26	7.90	8.75
	2016	10.09	9.84	12.20	10.59	9.21	9.38
	All	9.33	9.53	11.25	10.29	8.49	9.06
Job complexity	2014	3.41	1.02	3.58	0.99	3.33	1.10
	2015	3.12	1.36	3.43	1.30	2.99	1.36
	2016	3.31	1.24	3.51	1.21	3.22	1.25
	All	3.26	1.23	3.5	1.18	3.16	1.24
Duration of education	2014	11.78	2.17	11.86	2.40	11.74	2.06
	2015	11.78	2.24	11.90	2.35	11.73	2.19
	2016	11.83	2.18	11.89	2.33	11.80	2.12
	All	11.80	2.20	11.89	2.35	11.76	2.13
Work experience	2014	18.81	11.69	19.47	10.35	18.51	12.24
	2015	18.34	11.93	19.20	10.94	17.96	12.32
	2016	20.21	12.00	21.12	10.56	19.83	12.55
	All	19.06	11.90	19.86	10.65	18.71	12.38
Age	2014	43.43	11.82	42.80	10.66	43.72	12.32
	2015	43.49	12.00	43.1	11.02	43.66	12.40
	2016	44.99	11.91	44.95	10.55	45.01	12.44
	All	43.93	11.93	43.55	10.78	44.10	12.39

Source: SOEP Data 2014-2016, own calculations

Table 53. Statistical Significance of Group Differences in the Variation of Metric Independent Variables: T-Test for Independent Samples

Concept	Mean Difference		
	2014	2015	2016
Labor income	714.18***	673.13***	700.22***
Job tenure	2.27***	2.99***	2.99***
Job complexity	0.25**	0.44***	0.29***
Duration of education	0.12	0.17	0.09
Work experience	0.95	1.24	1.28
Age	-0.09	-0.06	-0.06

Note: Mean Difference = Control group value - Treatment group value

Source: SOEP Data 2014-2016, own calculations

Table 54. Descriptive Summary Statistics for Between- and Within-Observations Variation of Metric Dependent and Independent Variables

Concept	Variation	2014-2015				2014-2016			
		Std Dev	Min	Max	N	Std Dev	Min	Max	N
Training intensity: measures	*B*	1.13	0	9	1138	1.07	0	7.33	1640
	W	0.72	-5.47	6.53	632	0.82	-4.13	8.54	632
Training intensity: days	*B*	13.32	0	170	1138	9.67	0	100	1640
	W	10.23	-147.02	152.98	632	11.80	-97.20	202.80	632
Labor income	*B*	1359.15	0	11784.5	1138	1347.56	15	10223.67	1640
	W	325.84	-4621.11	8127.90	632	341.35	-3002.45	9746.55	632
Job tenure	*B*	9.20	0	43	1138	9.26	0	43.47	1640
	W	0.90	-2.76	20.74	632	1.29	-10.47	25.01	632
Job complexity	*B*	1.24	1	5	1109	1.22	1	5	1608
	W	0.44	1.75	4.75	631	0.44	1.60	5.26	631
Duration of studies	*B*	2.22	7	18	1101	2.22	7	18	1588
	W	0.17	9.28	14.28	609	0.16	0.28	2.95	609
Work experience	*B*	11.86	0	49.3	1122	11.91	0	49.8	1616
	W	0.49	17.55	19.55	625	0.77	17.06	21.06	625
Age	*B*	0.11	0.02	0.08	1155	0.01	0.02	0.08	1666
	W	0.00	0.04	0.04	632	0.00	0.04	0.04	632

Source: SOEP Data 2014-2016, own calculations

Table 55. Fixed Effects VS Random Effects in the Logistic Regression Model for Employer-Financed Training Incidence (2014-2015 Survey Years): Hausman Test

Explanatory variables	Estimated coefficients			
	Fixed effects	Random effects	Difference	Std. Error
Firm location	37.96	0.19	37.77	2704.55
Company size				
2. GE 20 LT 200	16.06	0.76	15.30	3300.20
3. GE 200 LT 2000	16.65	1.12	15.54	3300.20
4. GE 2000	18.63	1.45	17.17	3300.20
Labor income	-0.92	0.23	-1.15	0.96
Job tenure	604.81	31.49	573.32	2173.02
Job complexity	-1533.10	579.83	-2112.93	759.19
Contract duration	15.95	0.99	14.96	1543.31
Employment form				
2. Part-time employment	-16.43	-0.55	-15.88	5992.74
3. Marginal employment	-15.68	-1.98	-13.71	5992.74
Work experience	194.23	7.09	187.14	1395.63
Age	184.58	-37.17	221.75	2567.47
Test: Ho: difference in coefficients not systematic				
Chi2(9) = 12.77				
Prob >Chi2 = 0.17				

Note: Omitted variables

Source: SOEP Data 2014-2015, own calculations

Table 56. Fixed Effects VS Random Effects in the Logistic Regression Model for Training Incidence (2014-2016): Hausman Test

Explanatory variables	Estimated coefficients			
	Fixed effects	**Random effects**	**Difference**	**Std. Error**
Firm location	1.15	0.42	0.73	1.38
Business sector				
Wholesale, retail, repair of motor vehicles,motorcycles	-16.40	0.05	-16.45	2057.44
Accommodation,food service	-13.44	0.91	-14.35	64642.56
Transportation and storage	17.66	1.65	16.01	2866.68
Administrative and support service activities	-2.11	0.09	-2.20	6496.06
Education	-9.89	1.64	-11.53	64364.9
Human health and social work activities	-27.45	1.88	-29.33	64412.13
Other sectors	-32.91	0.80	-33.71	3821.37
Company size				
GE 20 LT 200	0.30	0.10	0.20	0.59
GE 200 LT 2000	0.66	0.60	0.07	0.75
GE 2000	1.47	0.72	0.74	0.80
Labor income	-0.20	0.09	-0.28	0.33
Job tenure	-544.78	0.20	-544.98	407.64
Job complexity	132.67	770.38	-637.71	227.96
Contract duration	-0.08	0.05	-0.13	0.52
Employment form				
Part-time employment	-1.34	-0.59	-0.75	0.76
Marginal employment	-2.30	-1.92	-0.39	1.16
Work experience	-114.98	2.39	-117.37	568.25
Age	500.49	-11.25	511.74	769.36
Test: Ho: difference in coefficients not systematic Chi2(11) = 10.56 **Prob >Chi2 = 0.48**				

Note: Omitted variables

Source: SOEP Data 2014-2015, own calculations

Table 57. Multicollinearity Diagnostics (Variance Inflation Factor): Random Effects Logistic Regression Models

Variable	VIF-1	VIF-2
Firm location	1.26	1.24
Business sector	1.08	1.08
Company size	1.15	1.17
Affection by the minimum wage introduction	1.15	1.14
Labor income	2.98	3.07
Job tenure	1.74	1.76
Job complexity	1.56	1.53
Contract duration	1.15	1.15
Employment form	2.03	1.98
Education level	3.88	4.01
Duration of studies	3.94	4.06
Work experience	5.91	5.98
Age	5.40	5.51
Gender	1.50	1.49
Migration background	1.13	1.15
Mean VIF	2.39	2.42

Note: VIF1-Incidence of employer-financed training (2014-2015); VIF2-Training incidence (2014-2016)

Source: SOEP Data 2014-2016, own calculations

Table 58. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction in Germany: Correlation Matrix of Coefficients (Part 1)

	Firm locat.	Sector-1	Sector-2	Sector-3	Sector-4	Sector-5	Sector-6	Sector-7	Comp. size-2	Comp. size-3	Comp. size-4	Affection
Firm location	1.00											
Sector-1	-0.11	1.00										
Sector-2	-0.05	0.39	1.00									
Sector-3	-0.02	0.41	0.35	1.00								
Sector-4	0.14	0.37	0.32	0.34	1.00							
Sector-5	0.01	0.39	0.32	0.34	0.30	1.00						
Sector-6	-0.01	0.52	0.42	0.50	0.41	0.50	1.00					
Sector-7	-0.04	0.53	0.42	0.50	0.40	0.50	0.62	1.00				
Comp. size-2	0.08	0.00	0.02	0.01	-0.02	0.11	0.02	0.11	1.00			
Comp. size-3	0.04	0.04	0.05	0.09	-0.03	0.10	0.09	0.14	0.72	1.00		
Comp. size-4	0.08	0.01	0.04	0.06	-0.03	0.14	0.15	0.17	0.70	0.77	1.00	
Affection by law	0.17	-0.08	-0.08	-0.06	-0.08	-0.08	-0.04	-0.06	-0.08	-0.08	-0.07	1.00
Labor Income	-0.24	0.15	0.16	0.16	0.08	0.08	0.12	0.09	-0.05	-0.11	-0.15	0.04
Job tenure	-0.07	0.05	0.00	0.03	0.03	0.09	0.10	-0.03	-0.02	-0.03	-0.05	-0.02
Job complex.	0.03	-0.06	0.07	0.06	0.02	-0.04	-0.06	-0.04	0.06	0.02	0.06	-0.02
Contract duration	0.02	0.00	0.01	0.01	-0.01	0.10	0.02	0.06	0.08	0.07	0.08	-0.07
Employm. form-2	-0.15	-0.02	0.07	-0.03	-0.01	-0.09	-0.16	-0.08	-0.01	-0.07	-0.12	-0.04
Employm. form-3	-0.19	-0.09	0.02	-0.02	0.01	-0.10	-0.10	-0.06	-0.03	-0.05	-0.10	-0.01
Education level-1	0.05	-0.04	-0.05	-0.06	0.02	0.04	0.03	0.01	0.05	0.01	0.04	0.06
Education level-2	0.03	-0.07	-0.03	-0.01	0.03	0.03	0.02	0.00	-0.01	0.00	0.02	0.11
Education level-3	0.00	0.02	-0.04	0.05	0.02	0.00	0.07	0.10	0.05	0.10	0.10	0.04
Education level-4	0.07	-0.05	-0.06	-0.06	0.01	0.02	0.03	0.00	0.02	0.04	0.08	0.15
Education level-5	0.05	-0.08	-0.06	-0.06	-0.01	-0.13	0.00	-0.03	0.00	0.02	0.03	0.14
Duration of studies	0.07	0.06	0.02	0.07	0.05	-0.04	0.01	0.01	0.01	0.00	-0.03	-0.18
Work experience	0.05	-0.09	0.00	0.07	0.06	0.04	0.06	0.02	0.00	0.03	0.05	0.08
Age	-0.03	0.06	-0.02	-0.12	-0.09	-0.10	-0.13	-0.06	-0.03	-0.06	-0.06	-0.05
Gender	0.00	0.14	0.13	-0.08	0.09	0.11	0.12	0.03	-0.02	-0.08	-0.07	-0.06
Mig.back-2	-0.28	0.07	-0.04	-0.06	-0.03	0.00	-0.09	0.00	-0.10	-0.07	-0.13	-0.02
Mig.back-3	-0.17	0.04	0.06	-0.03	0.05	0.04	-0.04	0.06	-0.05	-0.10	-0.17	-0.04
Year-2015	0.04	0.02	0.04	0.08	0.02	0.09	0.10	0.07	0.04	0.05	0.06	-0.07
Constant	-0.17	-0.20	-0.16	-0.16	-0.14	-0.08	-0.15	-0.17	-0.21	-0.17	-0.17	0.11
lnsig2u	0.11	0.10	0.13	0.27	0.06	0.27	0.37	0.24	0.19	0.26	0.30	-0.20

Source: SOEP Data 2014-2015, own calculations

Table 59. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction in Germany: Correlation Matrix of Coefficients (Part 2)

	Labor income	Job tenure	Job complex.	Contract duration	Employ. form-2	Employ. form-3	Educ. level-1	Educ. level-2	Educ. level-3	Educ. level-4	Educ. level-5	Duration of studies
Labor income	1.00											
Job tenure	-0.19	1.00										
Job complex.	-0.15	-0.10	1.00									
Contract duration	-0.10	-0.08	0.06	1.00								
Employ. form-2	0.29	-0.02	0.00	-0.08	1.00							
Employ. form-3	0.27	-0.05	0.08	-0.07	0.41	1.00						
Educ. level-1	-0.03	-0.02	-0.10	-0.11	0.03	0.08	1.00					
Educ. level-2	-0.07	-0.09	-0.07	-0.12	0.04	0.11	0.75	1.00				
Educ. level-3	-0.04	-0.10	-0.08	-0.08	0.00	0.04	0.58	0.53	1.00			
Educ. level-4	-0.13	-0.02	-0.11	-0.12	0.04	0.07	0.78	0.81	0.56	1.00		
Educ. level-5	-0.19	0.00	-0.09	-0.06	0.02	0.07	0.07	0.74	0.51	0.83	1.00	
Duration of studies	-0.02	0.06	-0.09	0.09	-0.08	-0.13	-0.05	-0.70	-0.40	-0.78	-0.76	1.00
Work experience	-0.04	-0.24	-0.07	-0.05	0.04	0.06	-0.01	0.08	0.04	0.06	0.06	0.08
Age	0.01	-0.02	0.14	-0.05	-0.05	-0.01	0.00	-0.06	-0.04	-0.09	-0.08	-0.06
Gender	-0.24	0.13	0.00	0.00	0.40	0.12	0.05	0.07	-0.02	0.08	0.05	-0.06
Mig. back.-2	0.24	0.16	0.07	-0.05	0.09	0.09	0.01	-0.13	0.01	-0.16	-0.11	0.15
Mig. back.-3	-0.03	-0.03	0.02	-0.05	0.05	0.08	0.00	-0.02	0.01	-0.06	-0.04	0.03
Year-2015	-0.02	0.02	0.04	0.01	-0.06	-0.08	-0.03	-0.04	-0.01	-0.02	-0.03	0.06
Constant	-0.02	0.00	-0.29	-0.22	0.02	0.05	0.21	0.45	0.22	0.53	0.56	-0.70
lnsig2u	0.09	0.15	0.03	-0.18	-0.18	-0.22	-0.75	-0.13	-0.03	-0.10	-0.15	0.24

Source: SOEP Data 2014-2015, own calculations

Table 60. Determinants of Employer-Financed Training Incidence under the Minimum Wage Introduction in Germany: Correlation Matrix of Coefficients (Part 3)

	Work experience	Age	Gender	Mig. backgr.-2	Mig. backgr.-3	Year-2015	Constant
Work experience	1.00						
Age	-0.86	1.00					
Gender	-0.14	0.11	1.00				
Mig. backgr.-2	-0.09	0.15	-0.05	1.00			
Mig. backgr.-3	0.04	0.02	0.04	0.24	1.00		
Year-2015	0.02	-0.06	-0.01	-0.06	-0.03	1.00	
Constant	0.29	-0.41	-0.07	-0.21	-0.02	-0.10	1.00
lnsig2u	0.05	-0.13	-0.11	-0.11	-0.15	0.22	-0.34

Source: SOEP Data 2014-2015, own calculations

Table 61. Employer-Financed Training Incidence and Type of Employment: Average Marginal Effects (Between-Group Comparison)

	2014	2015
	Treatment group. Baseline: Control group	
Full-time employment	-0.06	-0.07
Part-time employment	-0.06	-0.08
Marginal employment	-0.05	-0.07

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculations

Table 62. Determinants of Training Incidence under the Minimum Wage Introduction in Germany (Part 1)

	Firm location	Sector-1	Sector-2	Sector-3	Sector-4	Sector-5	Sector-6	Sector-7	Comp. size-2	Comp. size-3	Comp. size-4
Firm location	1.00										
Sector-1	-0.11	1.00									
Sector-2	-0.05	0.39	1.00								
Sector-3	-0.02	0.41	0.35	1.00							
Sector-4	0.14	0.37	0.32	0.34	1.00						
Sector-5	0.01	0.39	0.32	0.34	0.30	1.00					
Sector-6	-0.01	0.52	0.42	0.50	0.41	0.50	1.00				
Sector-7	-0.04	0.53	0.42	0.50	0.40	0.50	0.62	1.00			
Company size-2	0.08	0.00	0.02	0.01	-0.02	0.11	0.02	0.11	1.00		
Company size-3	0.04	0.04	0.05	0.09	-0.03	0.10	0.09	0.14	0.72	1.00	
Company size-4	0.08	0.01	0.04	0.06	-0.03	0.14	0.15	0.17	0.70	0.77	1.00
Affection by law	0.17	-0.08	-0.08	-0.06	-0.08	-0.08	-0.04	-0.06	-0.08	-0.08	-0.07
Labor income	-0.24	0.15	0.16	0.16	0.08	0.08	0.12	0.09	-0.05	-0.11	-0.15
Job tenure	-0.07	0.05	0.00	0.03	0.03	0.09	0.10	-0.03	-0.02	-0.03	-0.05
Job complexity	0.03	-0.06	0.07	0.06	0.02	-0.04	-0.06	-0.04	0.06	0.02	0.06
Contract duration	0.02	0.00	0.01	0.01	-0.01	0.10	0.02	0.06	0.08	0.07	0.08
Employment form-2	-0.15	-0.02	0.07	-0.03	-0.01	-0.09	-0.16	-0.08	-0.01	-0.07	-0.12
Employment form-3	-0.19	-0.09	0.02	-0.02	0.01	-0.10	-0.10	-0.06	-0.03	-0.05	-0.10
Education level-1	0.05	-0.04	-0.05	-0.06	0.02	0.04	0.03	0.01	0.05	0.01	0.04
Education level-2	0.03	-0.07	-0.03	-0.01	0.03	0.03	0.02	0.00	-0.01	0.00	0.02
Education level-3	0.00	0.02	-0.04	0.05	0.02	0.00	0.07	0.10	0.05	0.10	0.10
Education level-4	0.07	-0.05	-0.06	-0.06	0.01	0.02	0.03	0.00	0.02	0.04	0.08
Education level-5	0.05	-0.08	-0.06	-0.06	-0.01	-0.13	0.00	-0.03	0.00	0.02	0.03
Duration of studies	0.07	0.06	0.02	0.07	0.05	-0.04	0.01	0.01	0.01	0.00	-0.03
Work experience	0.05	-0.09	0.00	0.07	0.06	0.04	0.06	0.02	0.00	0.03	0.05
Age	-0.03	0.06	-0.02	-0.12	-0.09	-0.10	-0.13	-0.06	-0.03	-0.06	-0.06
Gender	0.00	0.14	0.13	-0.08	0.09	0.11	0.12	0.03	-0.02	-0.08	-0.07
Mig.back-2	-0.28	0.07	-0.04	-0.06	-0.03	0.00	-0.09	0.00	-0.10	-0.07	-0.13
Mig.back-3	-0.17	0.04	0.06	-0.03	0.05	0.04	-0.04	0.06	-0.05	-0.10	-0.17
Year-2015	0.04	0.02	0.04	0.08	0.02	0.09	0.10	0.07	0.04	0.05	0.06
Year-2016	-0.17	-0.20	-0.16	-0.16	-0.14	-0.08	-0.15	-0.17	-0.21	-0.17	-0.17
Constant	0.11	0.10	0.13	0.27	0.06	0.27	0.37	0.24	0.19	0.26	0.30
lnsig2u	0.10	-0.07	0.06	0.13	-0.09	0.14	0.08	0.01	0.08	0.15	0.17

Source: SOEP Data 2014-2016, own calculations

Table 63. Determinants of Training Incidence under the Minimum Wage Introduction in Germany (Part 2)

	Affection by law	Labor income	Job tenure	Job complex.	Contract duration	Employm. form-2	Employm. form-3	Educ. level-1	Educ. level-2	Educ. level-3	Educ. level-4
Affection by law	1.00										
Labor Income	0.06	1.00									
Job tenure	0.04	-0.22	1.00								
Job complexity	-0.02	-0.15	-0.14	1.00							
Contract duration	-0.01	-0.09	-0.14	0.07	1.00						
Employm.form-2	-0.04	0.28	0.03	-0.07	-0.04	1.00					
Employm.form-3	-0.03	0.30	0.02	0.02	0.02	0.45	1.00				
Educ. level-1	0.02	0.00	0.01	-0.05	-0.11	-0.01	0.01	1.00			
Educ. level-2	0.05	-0.07	-0.02	-0.05	-0.09	0.01	0.05	0.74	1.00		
Educ. level-3	0.05	-0.06	-0.03	-0.04	-0.09	-0.02	0.00	0.69	0.63	1.00	
Educ. level-4	0.09	-0.11	0.02	-0.07	-0.10	0.00	0.01	0.77	0.80	0.72	1.00
Educ. level-5	0.09	-0.16	0.07	-0.06	-0.05	0.01	0.04	0.65	0.73	0.62	0.81
Duration of studies	-0.11	-0.03	-0.02	-0.08	0.07	-0.07	-0.11	-0.49	-0.69	-0.52	-0.77
Work experience	0.06	-0.05	-0.23	-0.05	-0.07	0.02	0.03	-0.03	0.02	0.00	0.01
Age	-0.06	0.04	-0.01	0.12	0.01	-0.07	-0.04	0.00	-0.04	-0.04	-0.07
Gender	-0.02	-0.25	0.12	-0.03	0.04	0.36	0.15	0.02	0.08	0.02	0.07
Mig. back.-2	-0.01	0.05	0.17	0.08	-0.02	0.09	0.10	0.03	-0.14	-0.03	-0.17
Mig. back.-3	-0.10	-0.02	0.00	0.00	-0.03	0.04	0.08	0.00	0.00	0.01	-0.04
Year-2015	-0.01	-0.05	-0.03	0.02	0.00	-0.01	-0.02	-0.01	0.01	0.00	0.01
Year-2016	-0.03	-0.09	0.02	0.04	0.02	0.02	0.03	0.02	0.03	-0.02	0.07
Constant	0.00	-0.01	0.11	-0.26	-0.18	0.05	0.05	0.17	0.42	0.26	0.51
lnsig2u	-0.08	0.05	-0.10	0.11	-0.01	-0.24	-0.28	0.03	-0.06	0.07	0.00

Source: SOEP Data 2014-2016, own calculations

Table 64. Determinants of Training Incidence under the Minimum Wage Introduction in Germany (Part 3)

	Educ.level-5	Work experience	Age	Gender	Migration background-2	Migration background-3	Year-2015	Constant
Educ. level-5	1.00							
Work experience	-0.77	1.00						
Age	0.03	0.11	1.00					
Gender	-0.09	-0.05	-0.87	1.00				
Migration background-2	0.06	-0.08	-0.16	0.13	1.00			
Migration background-3	-0.13	0.18	-0.05	0.08	-0.06	1.00		
Year-2015	-0.02	0.03	0.02	0.04	0.04	0.21	1.00	
Constant	0.02	-0.01	0.00	-0.02	0.02	-0.02	0.00	1.00
lnsig2u	-0.08	0.14	0.07	-0.06	-0.17	-0.11	-0.06	-0.01

Source: SOEP Data 2014-2016, own calculations

Table 65. Heteroscedasticity Diagnostics (Breusch-Pagan / Cook-Weisberg Test): OLS Training Intensity Models

	2014-2015		2015-2016		2014-2016	
	TM	**TD**	**TM**	**TD**	**TM**	**TD**
Chi2	2.30	0.11	0.05	16.98	0.05	0.89
Prob >Chi2	0.13	0.74	0.83	0.76	0.83	0.34

Note: TM - Total number of overtaken training measures; TD -Total number of days within which overtaken training measures took place
Source: SOEP Data 2014-2016, own calculations

Table 66. Multicollinearity Diagnostics (Variance Inflation Factor): OLS Training Intensity Models

Variable	2014-2015	2015-2016	2014-2016
Firm location	1.08	1.30	1.36
Business sector	1.66	1.18	1.14
Company size	1.08	1.13	1.18
Affection by the minimum wage introduction	1.10	1.09	1.22
Labor income	1.02	1.02	1.15
Job tenure	1.90	1.93	2.36
Job complexity	1.14	1.45	1.21
Contract duration	1.03	1.95	2.39
Employment form	1.03	1.42	1.04
Work experience	1.42	1.08	1.48
Mean VIF	1.25	1.36	1.45

Source: SOEP Data 2014-2016, own calculations

Table 67. Training Incidence and Affection by the Minimum Wage Introduction: Average Marginal Effects (Between-Group Comparison)

	2014	2015	2016
Treatment group. Baseline: Control group	-0.04	-0.04	-0.04

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

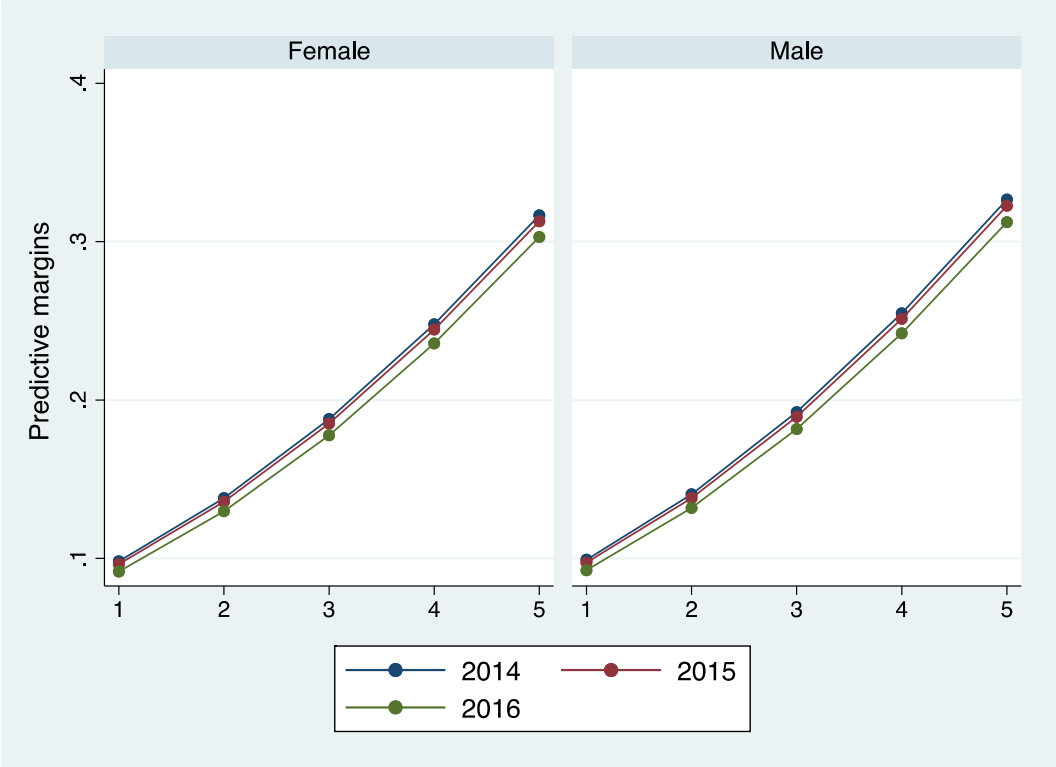
Table 68. Training Incidence and Affection by the Minimum Wage Introduction: Average Marginal Effects (Within-Group Comparison)

Survey year. Baseline: 2014	Control group	Treatment group
2015	0.00	0.00
2016	-0.01	-0.01

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2015, own calculations

Figure 15. Gender and Job Complexity – Training Incidence under the Minimum Wage Introduction: Conditional-Effects-Plot



Source: SOEP Data 2014-2016, own calculations

Table 69. Descriptive Statistics on Gender Composition of Business Sectors

	2014		2015		2016	
	Female	Male	Female	Male	Female	Male
Manufacturing	32.63	67.37	32.22	67.78	27.17	72.83
Wholesale and retail, repair	76.29	24.71	77.33	22.67	72.22	27.78
Accommodation and food service	74.19	25.81	70.37	29.63	69.44	30.56
Transportation and storage	33.33	66.67	33.33	66.67	30.23	69.77
Administrative and support service activities	65.31	34.69	60.47	39.53	52.94	47.06
Education	67.86	32.14	76.00	24.00	61.90	38.10
Human health and social work activities	80.60	19.40	79.69	20.31	82.61	17.39
Other sectors	50.00	50.00	50.00	50.00	57.61	42.39
Chi2	66.59***		63.95***		75.37***	

Note: *** p≤0.001, **p≤0.01, *p≤0.05

Source: SOEP Data 2014-2016, own calculations

Table 70. Baseline Sample Size for the Analysis of Training Intensity (Participants): Frequencies

	2014	2015	2016
Control group	46	53	45
Treatment group	72	73	70
Total	**118**	**126**	**115**

Source: SOEP Data 2014-2016, own calculations

Table 71. Change of the Variables in Training Intensity Models: Frequencies

	2014-2015		2015-2016		2014-2016	
	Control group	Treatment group	Control group	Treatment group	Control group	Treatment group
Dependent variables						
Number of enrollments	20	26	25	18	18	23
Training volume	23	34	26	25	23	26
Independent variables						
Firm location	1	1	0	0	0	3
Business sector	1	1	8	12	6	11
Company size	11	7	10	12	7	14
Affection by the minimum wage introduction	0	39	32	35	0	32
Labor income	25	33	29	27	22	28
Job tenure	29	39	32	35	26	32
Job complexity	5	3	1	3	4	2
Contract duration	1	4	2	4	1	1
Employment form	0	3	0	3	1	4
Work experience	28	37	30	31	26	29
Valid observations	**29**	**36**	**32**	**33**	**26**	**29**

Source: SOEP Data 2014-2016, own calculations

Table 72. Change of the Number of Enrollments under the Constant Training Volume: Frequencies

Change of the number of enrollments (Value)	Frequency
-2	1
-1	4
0	19
1	2
7	1
Total	**27**

Source: SOEP Data 2014-2016, own calculations

Table 73. Change of the Training Volume under the Constant Number of Enrollments: Frequencies

Change of the training volume (Value)	Frequency
-197	1
-30	1
-27	1
-25	1
-19	1
-18	2
-15	1
-10	1
-7	1
-5	1
-4	1
-3	2
-2	2
-1	1
0	19
2	1
4	2
5	1
7	2
14	1
22	1
48	1
49	1
Total	**46**

Source: SOEP Data 2014-2016, own calculations